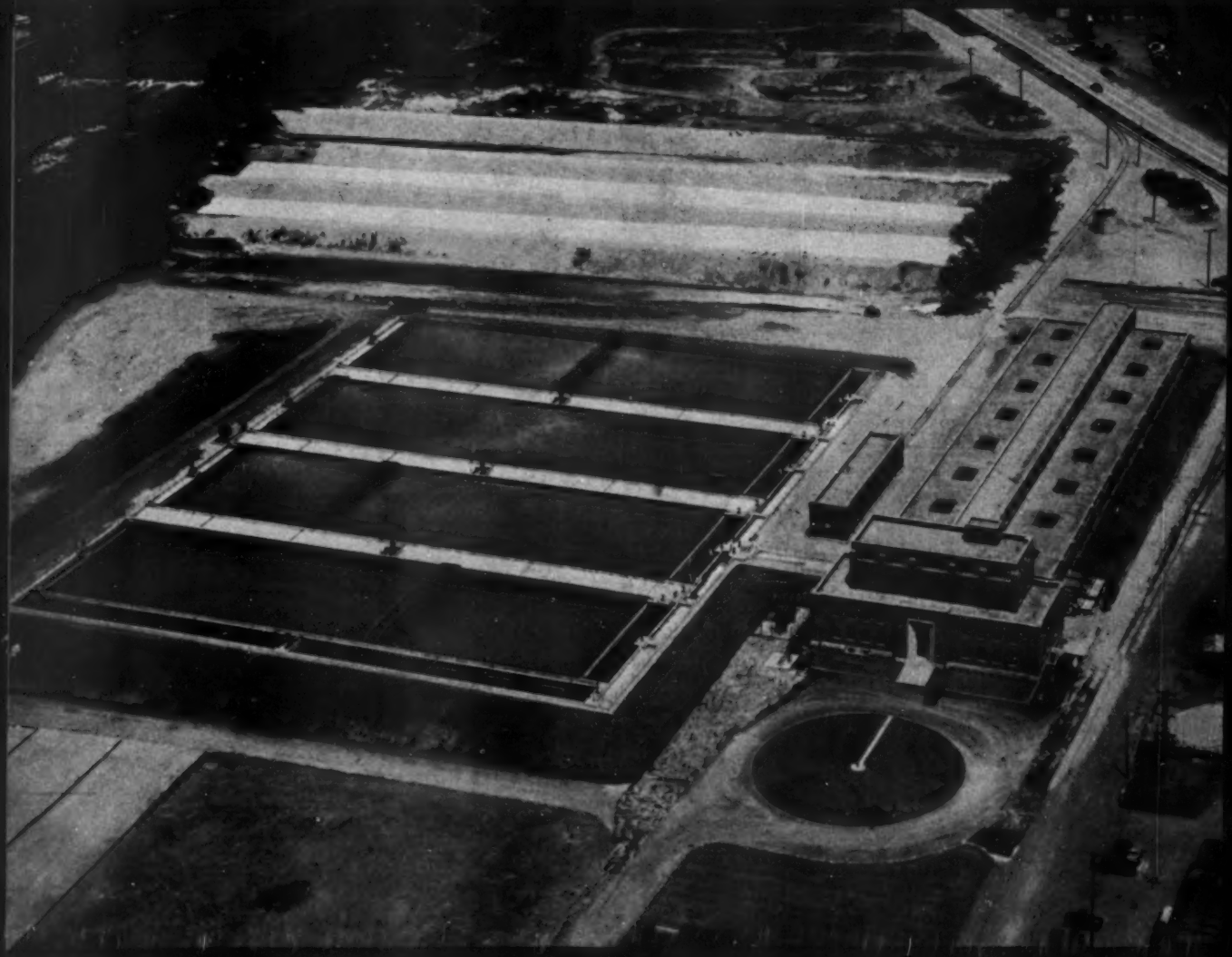
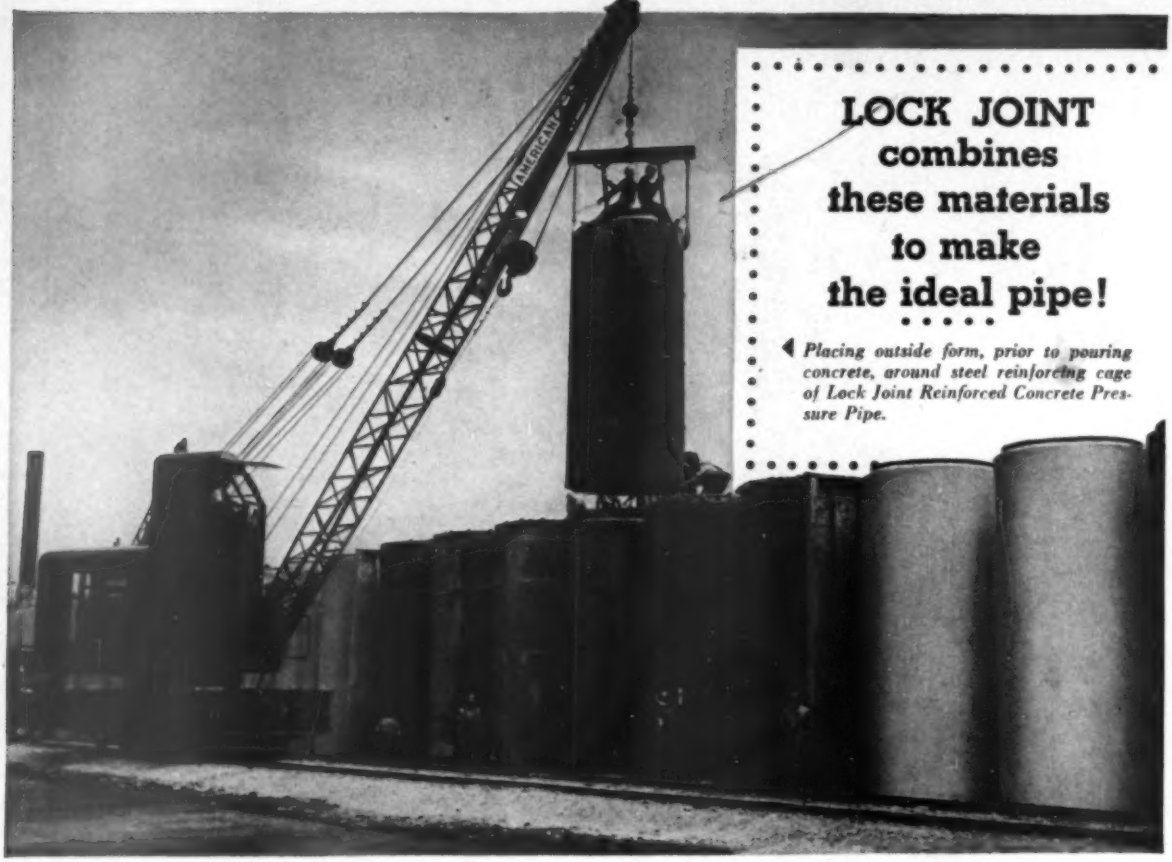
WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



There's no substitute for CONCRETE and STEEL!



LOCK JOINT combines these materials to make the ideal pipe!

Placing outside form, prior to pouring concrete, around steel reinforcing cage of Lock Joint Reinforced Concrete Pressure Pipe.

CONCRETE, with its proven qualities of durability, non-corrosion, resistance to electrolytic action, and high compressive strength is combined, by Lock Joint, with steel's toughness, resilience and high tensile strength to make a pipe that retains the best qualities of both—non tuberculance, high structural strength and long life with little or no maintenance. Dense concrete affords complete protection for the quality reinforcing steel. Both materials are carefully calculated to meet your pressure needs with a wide factor of safety. The Lock Joint Pipe Company's Rubber and Steel Joint is extremely watertight and, at the same time, flexible.

For superior strength, carrying characteristics and trouble-free operation, let Lock Joint supply your pipe needs in sizes 16" and larger.

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16" in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

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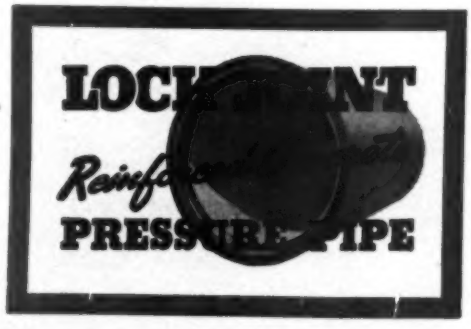

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INDUSTRIAL WASTE TREATMENT

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"SEWAGE WORKS PRACTICES" are discussed by *Prof. Don. Bloodgood*

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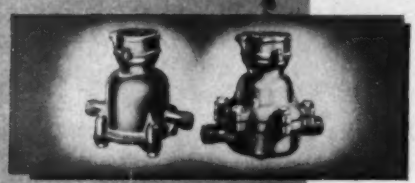

BADGER meters conserve it!

More than 25 million acres of crops must be irrigated to provide America's food supply. The Badger water meters used in thousands of communities throughout the nation help save water for this vital need . . . measure water accurately for homes and industry . . . provide a precise check on water usage and waste. With their outstanding record of performance, Badger meters have won the praise of waterworks men everywhere... are known as the meters that save water, work, money!

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"Measuring the water of the world"

Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

WINTER OR SUMMER, in the hills or on the flats, make no difference to cast iron pipe. Whether it is used for a water supply line, a gas feeder main or a pressure sewer, cast iron pipe has a rich history of highly satisfactory performance behind it for each type of service.

U. S. pipe centrifugally cast in metal molds up to 24-inch, pit cast pipe in the larger sizes and fittings are made in accordance with Federal, American Standard and American Water Works Association specifications wheresoever they apply.

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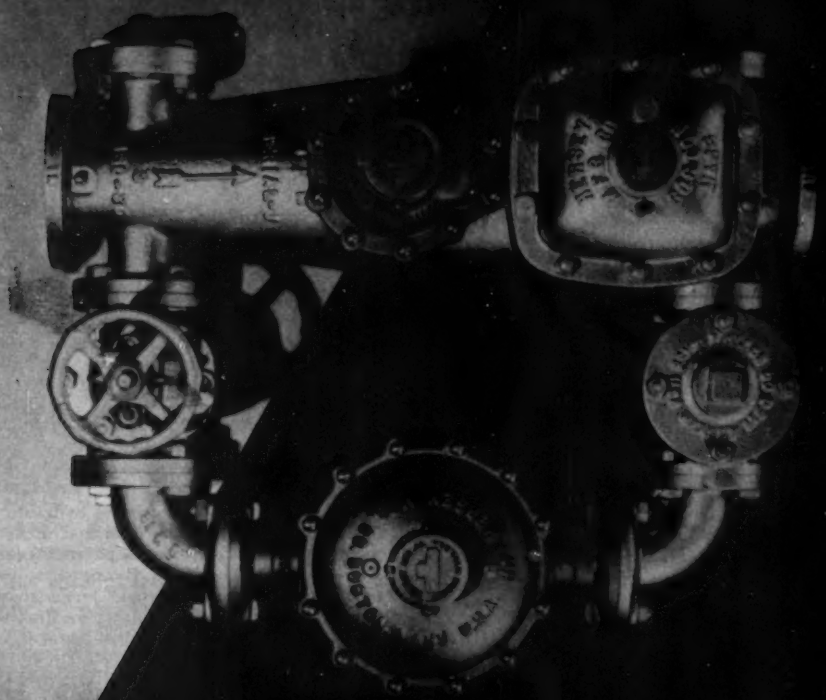

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NEW OLIVER 88WT Hydro-Trencher

Digs to 10 feet in toughest going!

Here is a trencher that won't stop when it comes to rocks or roots. Tremendous hydraulic down pressure forces the half-yard bucket into the ground for a fast, full load. New dual-circuit control gives constant pressure, more positive control and greater flexibility in any kind of going.

Take a close look at this new trencher. It reaches long and digs deep. Its simple, sturdy construction and all-hydraulic operation give low maintenance and long service. The hydraulic stabilizer blade not only holds the tractor level and steady, but is an excellent back-filler blade. And, by simply turning the trencher bucket around you have an efficient swing loader.

Test the new Oliver 88WT Hydro-Trencher on your work. See how easy it is to operate and how readily it digs or loads the toughest material. And remember, the 88WT is ready to work or move instantly, and takes only one man to operate. Get in touch with your Oliver Industrial Distributor for a demonstration, soon!

Right through the roadbed! Powerful hydraulic down pressure digs through this material with ease. Positive dual-circuit control gives a choice of *three* separate lift or drop speeds on the boom for any condition. Bucket rotation and dipper stick design permit clamping rocks larger than the bucket itself. Special boom cylinder available for digging to 12 feet.

It's a swing loader, too! Remove the bucket hinge pin and turn the bucket around. In minutes the trencher becomes a loader. No extra parts are needed. The exceptional bucket rotation permits loading into a truck up to 10 feet, 6 inches. Optional loading bucket loads up to 12 feet.

One-half yard bucket! The fast hydraulic operation and big bucket capacity of the 88WT let you do more in less time. All-hydraulic operation means, too, that there are no expensive cables or clutches to replace. Maintenance is simple and low cost.

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

AMERICAN Pipe for Every Service Condition

The above illustration shows an outfall sewer line at Dunedin, Florida, which was constructed of 20" AMERICAN Double-X mechanical joint pipe. It extends about one quarter mile into St. Joseph Sound for disposal of the effluent from the sewage disposal plant. The assembled pipe line was floated out from shore with a bulldozer supplying the thrust at the shore end.

Manufactured under rigid specifications in diameters of 2" through 48", AMERICAN Double-X pipe will stand the impact of heavy loads and gives complete job satisfaction. AMERICAN Double-X pipe is conveying water, sewage, gas, crude oil, gasoline, sour naphtha, salt brine—and in fact, just about everything that a pipe line can conceivably convey. It is carrying these products under operating pressures ranging from a few psi up to pressures in excess of 100 psi gas and 500 psi liquid.

A complete line of fittings for use with AMERICAN Double-X pipe is available including transition pieces for inter-connecting with other types of joints and pipe.

Refer your next piping job to AMERICAN CAST IRON PIPE. Let us assist you by taking off lists of material and submitting a price on pipe and fittings for your next job.

Write for AMERICAN Double-X pipe booklet. A free copy will be sent on request.

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Gentlemen: Please send me a free copy of your new illustrated booklet, *"American Double-X Mechanical Joint Pipe."*

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FOR 100 YEARS

Photo: Ewing Galloway

This is Chicago, second largest city in the U. S. A.—population over 3½ million.

Print: Bettmann Archive

A view of Lake Street, Chicago, as it looked 100 years ago.

MODERNIZED cast iron

they've been coming back for more...

CHICAGO installed cast iron water mains 100 years ago... and installs them today!

Chicago's skyline has changed magically in a century but the underground lines that transport water are still cast iron. Nearly 100% of her water distribution system consists of cast iron pipe. This city of "magnificent distances" has over 4,000 miles (21 million feet) of cast iron mains, supplying more than one billion gallons of water per day to a population approaching four million.

Section of a century-old cast iron main still serving in Chicago's vast water distribution system.

A famous jurist defined *good will* as the "probability of the customer's returning to the old stand." Chicago's Water Department has been coming back for more cast iron pipe for 100 years. That's good will—yes—built on proved performance. Chicago has century-old cast iron pipe in its water distribution system.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association,
Thos. F. Wolfe, Managing Director,
122 So. Michigan Ave., Chicago 3.

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The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS OPERATION

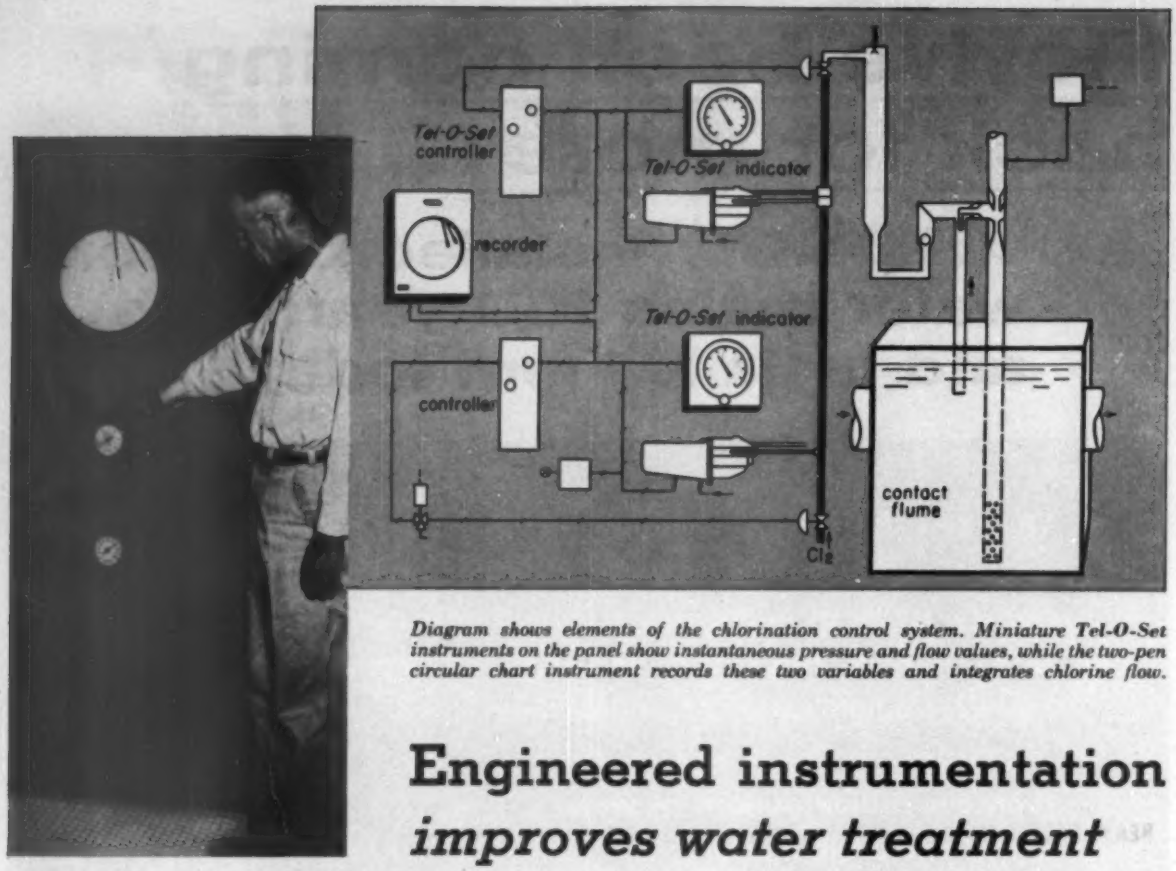

Diagram shows elements of the chlorination control system. Miniature Tel-O-Set instruments on the panel show instantaneous pressure and flow values, while the two-pen circular chart instrument records these two variables and integrates chlorine flow.

Engineered instrumentation *improves water treatment*

THE SIMPLE, practical method of controlling chlorination used at the Corpus Christi filtration plant exemplifies how modern instrumentation can automatically regulate difficult treatment processes. Two *Tel-O-Set* pneumatic control systems team up on this installation: one controls chlorine pressure and the other regulates flow. Together they hold chlorine feeding accurately at the required dosage, under widely varying water demand that reaches forty million gallons per day. The complete instrumentation functions continuously with minimum attention by plant operators, and needs practically no maintenance.

A key element in *Tel-O-Set* systems is the Differential Converter. This mercuryless manometer gives quick, precise response . . . is unaffected by the pure, dry chlorine . . . and is equally applicable to a host of other flow, pressure or liquid level measurements on a variety of fluids.

Whatever your specific problem may be, engineered instrumentation by Honeywell can give you an effective, economical solution. *Tel-O-Set* systems are composed entirely of interchangeable components —and are priced the same for all available components. At your service is a broad line of measuring and controlling equipment, implemented by extensive Honeywell experience in all types of processes used for treatment of water, sewage and industrial waste.

Your nearby Honeywell sales engineer will be glad to discuss your applications with you and your consulting engineer. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

● REFERENCE DATA: Write for Bulletin 7302, "Instrumentation for water, sewage and industrial waste treatment."

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BROWN INSTRUMENTS

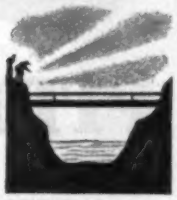
First in Controls

6 Good Reasons for using this Superior Steel Pipe

When you consider a new sewage line, you want tested steel pipe that is strong, resilient, economical to handle and install, and above all, leakproof. Bethlehem Tar-Enameled Steel Pipe meets these qualifications. Here are six good reasons why you'll find it the ideal pipe for all types of sewage:

1. BEAM STRENGTH

Bethlehem Tar-Enameled Steel Pipe is made from high-quality steel plate. It's a husky pipe, with great beam strength. It can be handled in multiple lengths, and is unaffected by washouts.



2. CORROSION-RESISTANCE

Bethlehem Pipe is lined and coated with a smooth layer of coal-tar enamel, meeting AWWA Specifications. The enamel is impervious to corrosion and incrustation and ensures high flow-coefficients.

3. SHOCK-RESISTANCE

Bethlehem Steel Pipe is designed with a safety factor of about 4 against bursting. It is resistant to water-hammer, and can carry a load of nearly four times the working pressure.

4. LEAKPROOF JOINTS

Bethlehem Pipe makes a tight line, with joints made by mechanical couplings, welding or riveting. It safely spans washouts caused by floods, or by leaky joints in lines made of other materials.

5. RESILIENCE

Bethlehem Steel Pipe has the resilience to "give" under soil movement. It is immune to surface vibrations caused by heavy vehicular traffic, making possible years of dependable service.

6. LONG LENGTHS

Bethlehem Steel Pipe generally comes in 40-ft lengths. This reduces the laying cost, as only 132 joints are required per mile. It is made in any diameter from 22 in. i.d., and in any wall thickness.

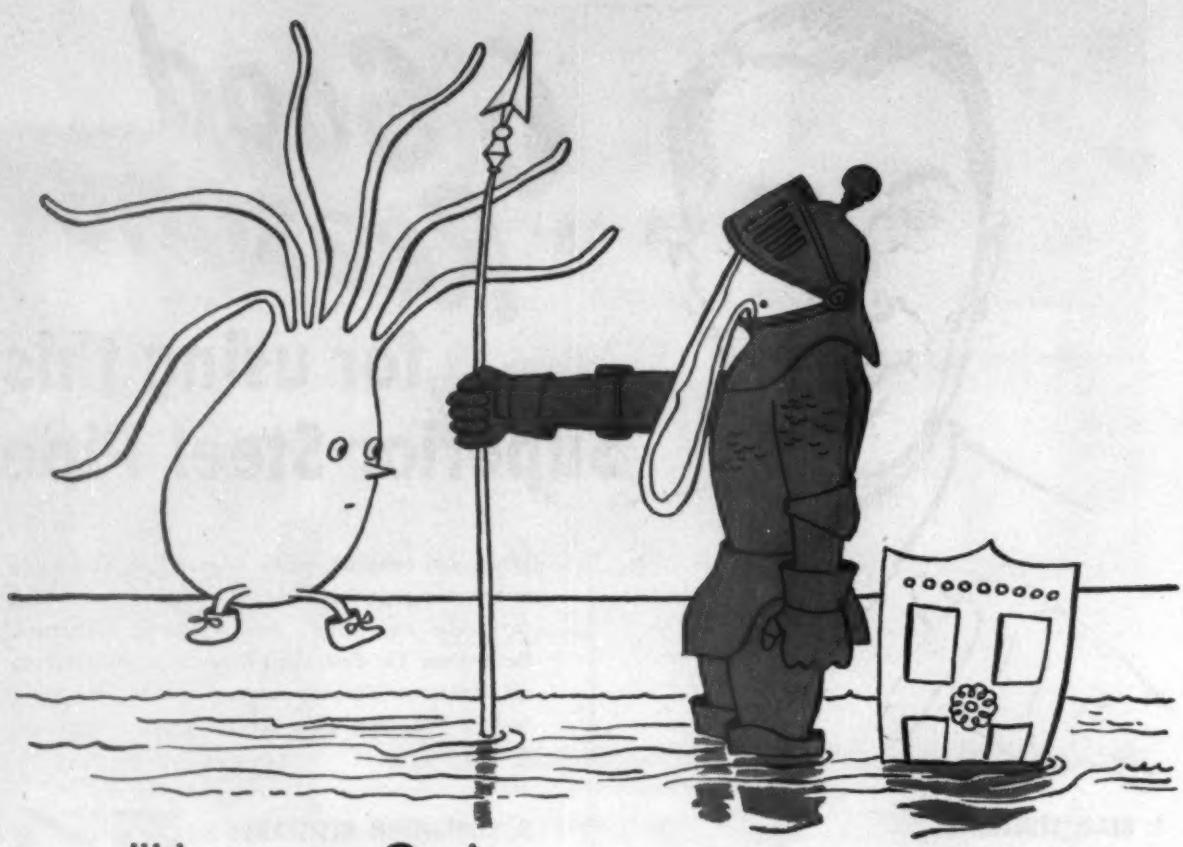
A Bethlehem representative will be pleased to supply additional information about tar-enameled pipe. All you need do is contact the nearest Bethlehem office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM *Tar-Enameled* STEEL PIPE



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That's right, Orgie. Discretion is the better part of valor. Chlorine-susceptible bacteria and algae don't have a chance against the germ-killing powers of Pittchlor.

Pittchlor, the high-test calcium hypochlorite containing a minimum of 70% available chlorine, kills microorganisms on contact. That's why Pittchlor works so fast and effectively in chlorinating water supplies, treating sewage, or wherever else the germicidal and deodorizing action of chlorine is needed.

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are your

STRONGEST

branch main connections!

Any movement of a branch main creates high stresses at the branch main connection. Mueller tapping connections are specifically designed with heavy ribs to actually strengthen the main. Connections may be made quickly, under pressure, without loss of water or interruption of flow.

The heavy, corrosion-resistant bolts have self-holding heads and are closely and evenly spaced in perfect alignment along the side flanges of the sleeve for maximum rigidity. The wide, thick side flanges are grooved for positive retention of the lead gaskets to assure a lifetime watertight joint.

A simple flanged connection between the tapping sleeve and tapping valve assures positive alignment for accurate drilling and ease of installation.

Mueller Mechanical Joint Sleeves can be adapted to fit all classes of cast iron pipe by changing the end gaskets. The raised cast ring in the calked joint sleeves centers the ring and keeps the use of expensive lead to a minimum.

Mueller Tapping Valves have oversize seat openings to allow the use of full-size shell cutters.

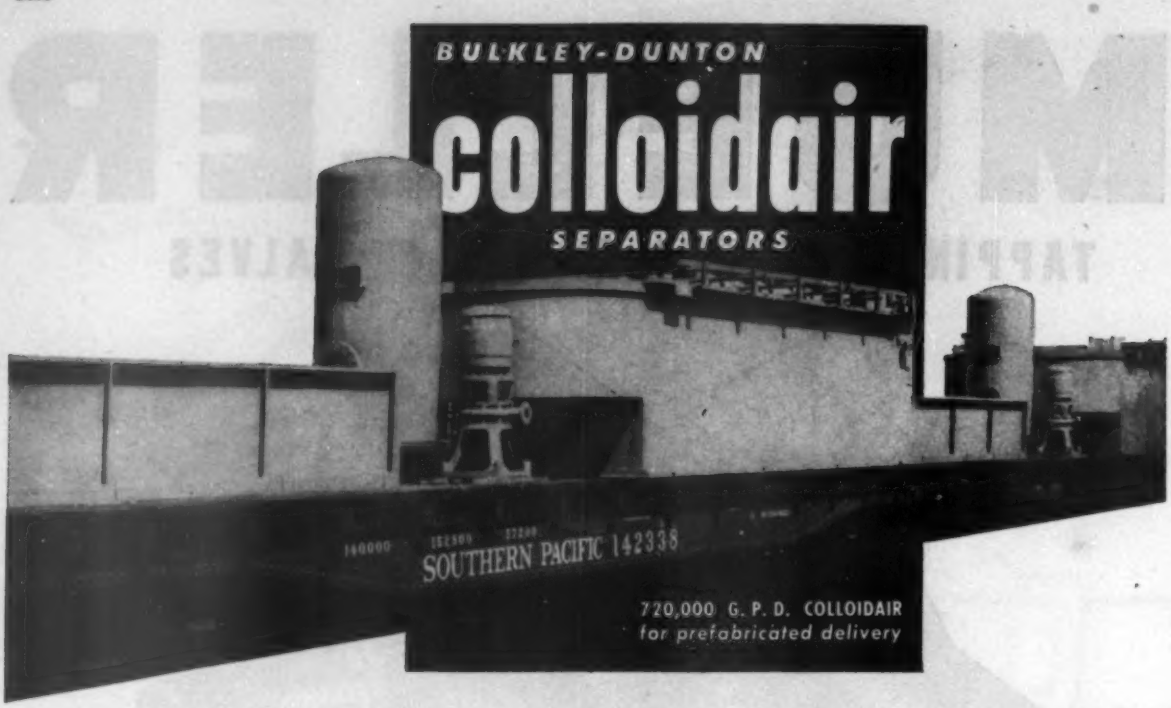
Tapping valves can be furnished with either "O" ring packing or conventional packing and mechanical joint or hub end outlet.

Consult your Mueller Water Works Catalog W-96 or see your Mueller representative for full details.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS



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2. INDUSTRIAL WASTE TREATMENT

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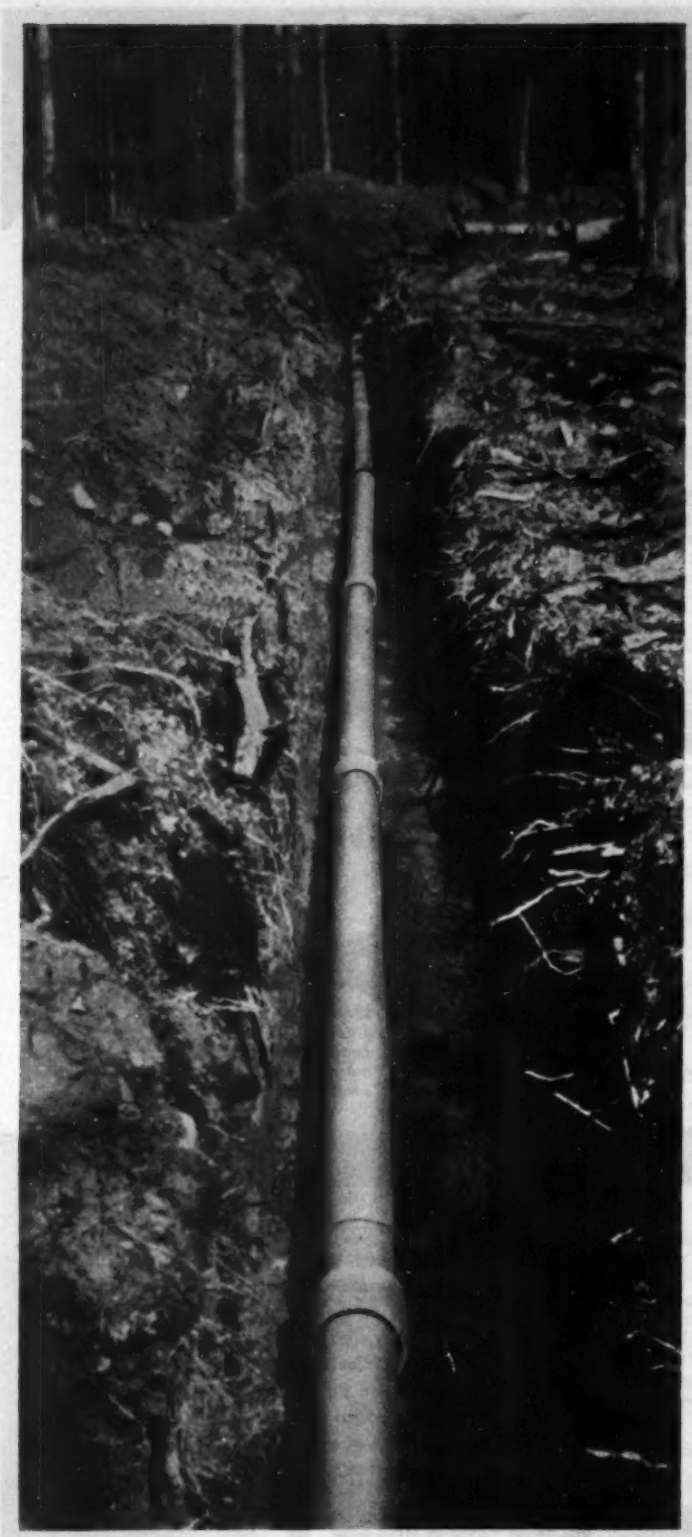


"Century"

ASBESTOS-CEMENT PIPE

installed in Penna. State Park

Hickory Run State Park in White Haven is one of several Pennsylvania Parks in which "Century" pipe has been used to supply water for recreational areas. For generations to come, this line will carry its full capacity, without the need for maintenance.

Long, trouble-free service is to be expected of "Century" pipe. Being non-metallic, this exceptionally strong, durable pipe cannot tuberculate, rust, or corrode. Its bore stays smooth and frictionless, keeping pumping costs low. It is light in weight, easy to lay, low in cost.

Before you decide on the pipe for *any* water-carrying line, for economy's sake you ought to find out all about "Century" pipe. Write for "Mains Without Maintenance"—an informative free booklet of real value to anyone concerned with water main construction.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

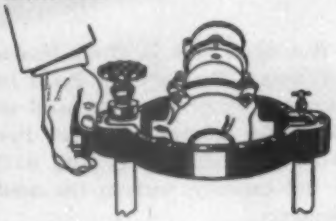
Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

Meter Installation And Removal Now Simplified

With the use of Clark Meter Yokes, installation or removal of meter is a simple job requiring only a few seconds' time. Only one hand is needed, assuring ample visibility in the box.

Closing Valve. A few easy turns close the water-way without use of tools. Try-cock on outlet side indicates faulty meter without removing it from service.

Releasing Meter is accomplished with a few turns of handwheel. Meter tips and rests on yoke frame. It cannot fall over frame and drop to bottom of meter box.

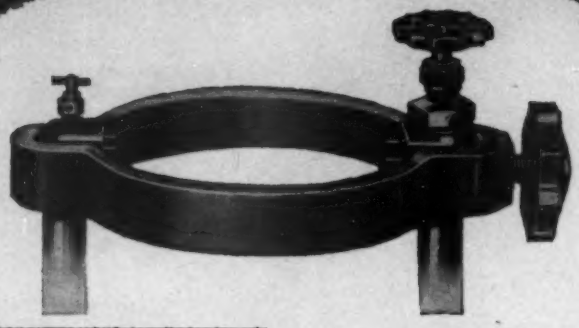


Removing Meter. Just lift out. Gaskets stay in position and need no replacement. No connections are screwed on the meter and no tools are needed.

Sealing Service is accomplished by removing frame of Clark Meter Yoke. Fittings cannot be connected until frame is replaced by water department.

For further details and features of these time-saving meter yokes, we suggest that you write the manufacturer, H. W. Clark Co., Mattoon, Illinois . . . mentioning this article and publication.

CLARK METER YOKES
For Easy One-Hand Operation



No. 4 CLARK METER YOKE. Installation is made without bolts, rivets or screws. Outlet try-cock ell determines condition of meter and inlet control valve ell facilitates easy exchange of meters.

Try-cock Ell

Valve Ell

Bronze Ell and Valve with Copper Connections.

SPACER CLAMP ties riser pipes together rigidly at bottom of meter box and automatically liberates meter when handwheel is loosened.

Thanks to simplified design and construction, Clark Meter Yokes permit easy one-hand operation. They are manufactured in a minimum number of sizes to meet every requirement of simplified operation. Because they eliminate so many parts, Clark Meter Yokes are also economical. Costs of meter couplings, curb stop, service box and several pipe fittings are saved. Circular one-piece cast iron frames give added strength, and these yokes are quickly installed on any type of service line. Available for either iron or copper pipe. To get all the details . . .

Write

H. W. CLARK CO.
MATTOON, ILLINOIS

OVER 2000 REX CONVEYOR SLUDGE COLLECTORS IN OVER 700 CITIES AND INDUSTRIES!

WHAT BETTER PROOF of Rex superiority?

YES over 700 cities and industries rely on Rex® Conveyor Sludge Collectors for efficient, dependable and economical operation. These precision engineered sludge collectors are applicable for all types of sludge handling or surface skimming conditions in either sewage, water or industrial waste treatment application . . . no application is too large or too small . . . and each receives the full benefit of Rex Engineering.

Here are some of the outstanding time-proven features of Rex Sludge Collectors that make them leaders in their field:

★ ***Balanced Equipment Design***—design proportionate throughout.

★ ***Rex Z-Metal Chain*** and attachments—corrosion and wear resistant.

★ ***Self-Aligning Bearings***—easy to install. Compensate for tank irregularities . . . prevent accumulation of settled solids.

★ ***Offset Split Drive Sprockets***—eliminate bulky cantilevered brackets. Easy to replace.

★ ***Centralized, Hardened Wearing Shoes***—eliminate splitting strains on wooden scraper flights. Means longer life, lower maintenance.

★ ***Double Life Sprockets***—chain engages only every other sprocket tooth.

★ ***Drive Unit***—compact, totally enclosed. Shear pin protection. Jaw clutches provided where independent operation is required.

★ ***Sub-Assemblies***—shop assembly of drive units and shaft assemblies assure proper alignment and fit.

MAKE SURE YOU WILL BE THE NEXT ONE to profit from Rex design and Rex quality. Get all the facts on Rex Conveyor Sludge Collectors. Call your nearest Rex Sanitation Engineer or write for Bulletin 47-9. Chain Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wisconsin.

REX®

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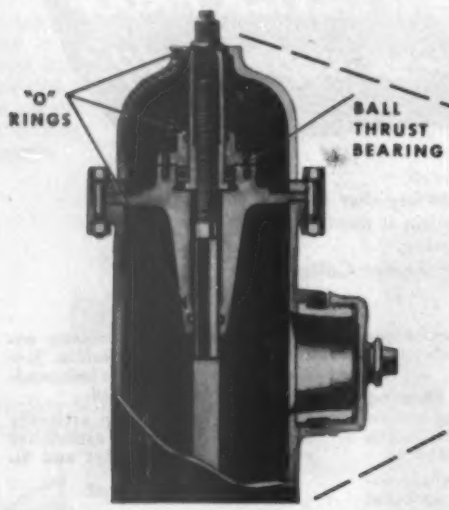
In Cuyahoga Falls...

Darling hydrants for 45 years ...now DARLING B-50-B's are going in!

EASIER maintenance and rugged construction . . . basic design advantages of Darling hydrants and valves . . . have been paying off in Cuyahoga Falls, Ohio, since way back in 1908. In the words of City Engineer T. H. Sauter, "The City of Cuyahoga Falls has been a user of Darling hydrants and valves since 1908. The ease with which repairs can be effected has been a factor in the determination of the city to standardize on this type of equipment."

Darling B-50-B's Bring Unique, New Advantages!

Cuyahoga Falls, and hundreds of other cities too, are now installing the new Darling B-50-B hydrants. This dry-top, ball-bearing hydrant opens quicker, operates easier, and eliminates bothersome packing lubrication. Moreover, the special Darling B-50-B "O" rings are insurance against loss of lubricant for threads and bearings . . . *and never let a drop of water reach the operating threads.*



Before you decide on any hydrant or valve, get all the facts on the new Darling B-50-B hydrant and Darling water valves for every service. *Write today!*

DARLING VALVE & MANUFACTURING CO.
Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario

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is an integral part of the Continental Can family

In the past, many of the most outstanding developments in plastic piping have come from Elmer E. Mills Plastics, Inc. They'll continue to come from the Mills Plastic Pipe Division of Continental Can Company. We are pleased to welcome Mills people into the Continental organization...we pledge ourselves to uphold the reputation they have earned for the finest in product and service.

flexible
POLYETHYLENE
For rapid, low-cost installation of two-pipe jet wells, and lines for city water, irrigation, transfer of gases, vapors, suspended solids.
RIGID
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Widely used in chemical processing, by petroleum industry, agriculture and utilities. Economical for gas mains and service lines. Non-corrosive.

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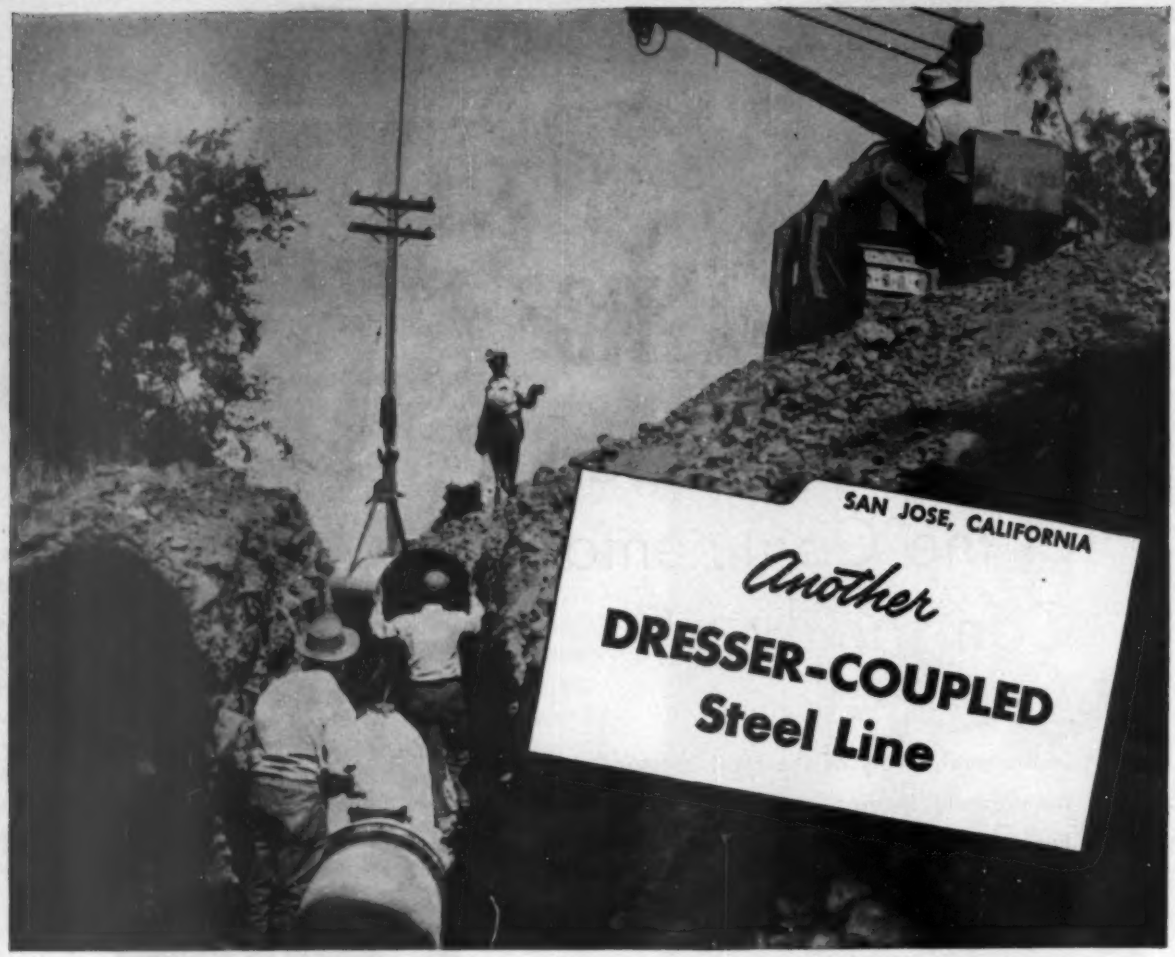


DELIVERS WATER CHEAPER

San Jose installs 12-mile Dresser-Coupled steel line . . . augments water supply from new reservoir.

Crossing the new Water Conservation District reservoir—replacing 8,000 ft. of flume, now submerged—this Dresser-Coupled steel line carries an increased water supply to San Jose, Los Gatos and Saratoga, California. Having installed over 200 miles of steel pipe since 1946, San Jose engineers are well acquainted with the many advantages of Dresser-Coupled construction.

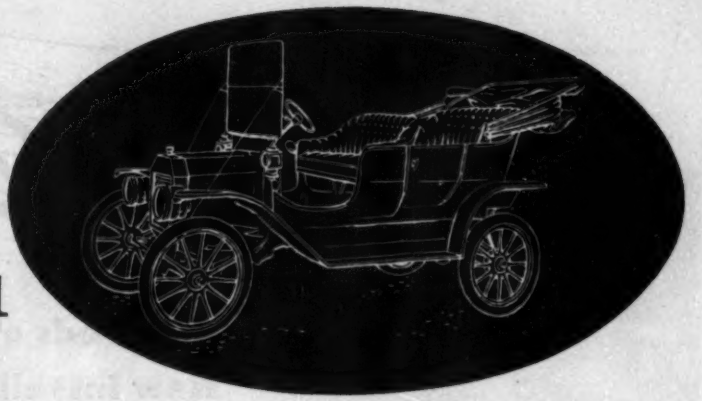
The beam strength of lighter weight steel pipe, plus the resilience of both pipe and couplings, assures a permanently tight line unaffected by surface shock, ground shift or washouts. Rugged coatings make the line impervious to corrosion and incrustation. Glass-smooth pipe linings sustain high flow-coefficients.

Long pipe lengths require fewer joints per mile —reduce laying costs. Small crews, with a minimum of skill, supervision and heavy equipment, make Dresser joints faster, surer—speed construction schedules. This adds up to lower cost, maintenance-free lines.

✓ ***BE SURE*** **you get the *best* line at the *best* price. Always put steel pipe and Dresser Couplings in your specifications.**

DRESSER COUPLINGS

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: Toronto, Ont.

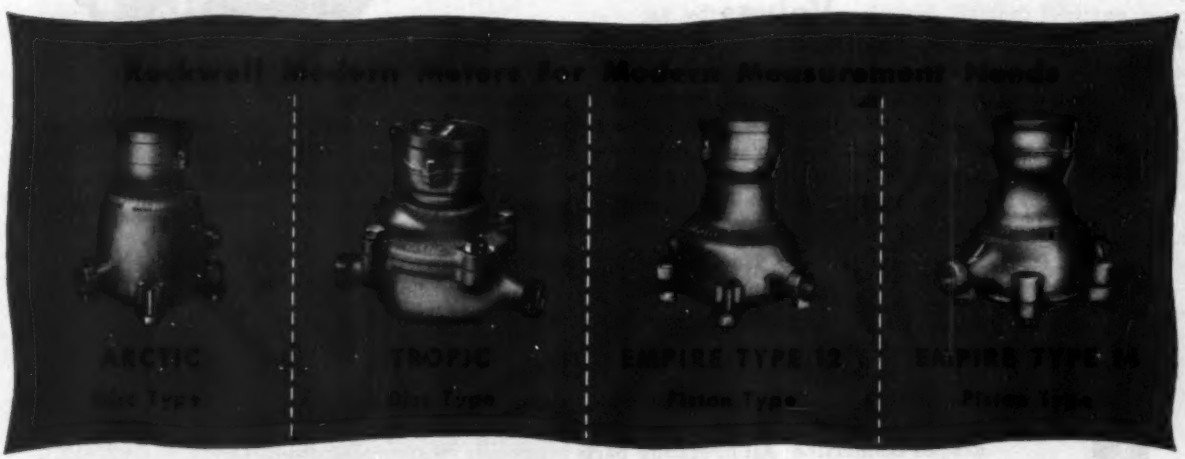


Would you keep on repairing a 1912 car?

There are many thousands of meters purchased thirty or more years ago still in service. They are being periodically repaired—frequently rebuilt from the old meter case up. This practice can impose a tremendous burden of trouble and expense on a water utility, especially at today's higher labor rates.

Many management men, with an eye towards costs, know these facts. They know that a new Rockwell meter will measure 95% of the ¼ gpm or smaller flows as against 90% or less for a repaired meter. They realize that if the cost of repairing an old meter amounts to half the cost of a new meter, they are better off to buy a new one.

Here at Rockwell we've worked constantly for improvement and our meters show it. They will measure at top accuracy for longer periods at lower costs. You can buy them with full confidence in their ability to cut your operating and maintenance costs and increase your revenue.



The Symbol for Service, Quality and Performance in Water Meters

ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PA. Atlanta Boston Chicago Houston
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Saved!

...Hundreds of Man-Hours on New Installations

YOU
CAN NOW DO AN ALL
MECHANICAL-JOINT JOB
WITH
PIPE, FITTINGS, VALVES AND
HYDRANTS

...with EDDY Mechanical-Joint Valves

After excavation, two unskilled workmen and a ratchet wrench can install Eddy Mechanical-Joint Valves in a jiffy. This can mean many man-hours saved each year. What's more, the work can be done in a flooded trench, or in any kind of weather—for no caulking, no lead-melting is needed . . . and all joints are *bottle-tight* under pressure. Valves meet AWWA specifications, and are available in sizes 3" to 12" for use on both sand-cast and centrifugally-cast iron water pipe.

...and EDDY Mechanical-Joint Fire Hydrants

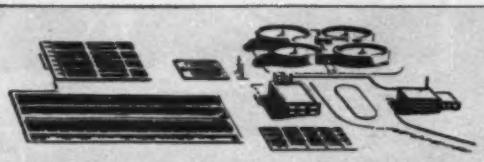
Since 1849 EDDY For Long Service

Mechanical-Joint connection allows quick, easy installation or removal (with or without auxiliary valve). Hydrants also available with bell or flanged connection. All operating parts accessible by removing top cover. Hydrants open fast, close easily. Even a bent stem does not cause water loss, and drip-action prevents freeze-up. Stock up now on both Clow Mechanical-Joint Cutting-in Valves and Hydrants. Be ready to make easy, speedy installations when needed!

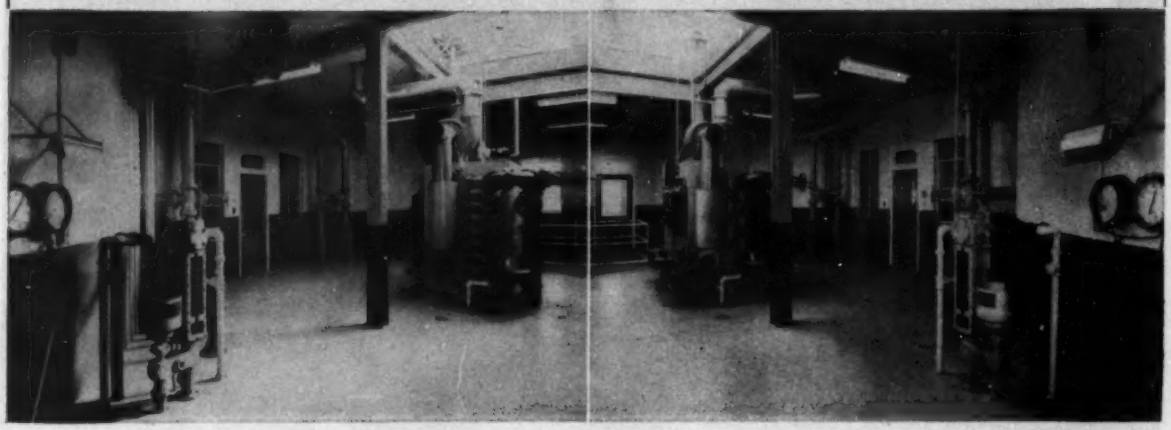
EDDY VALVE COMPANY

WATERFORD NEW YORK

A Subsidiary of James B. Clow & Sons



At Levittown, Pennsylvania *a large city grows. According to Reader's Digest, this fastest-growing community in the world is destined to become one of the 50 major cities in the nation. Their modern sewage plant was designed by Albright & Friel, Inc. with Levitt & Sons' Sanitary Engineer, F. J. Biele.*



operability in a control room layout designed for

P.F.T. "CONTROLLED DIGESTION" SYSTEM

This modern control room is part of a well-designed sewage treatment plant rushed to completion in connection with the Fairless Plant of U.S. Steel. The plant was planned for flexible capacity and simple operation with P.F.T. "Controlled Digestion" equipment.

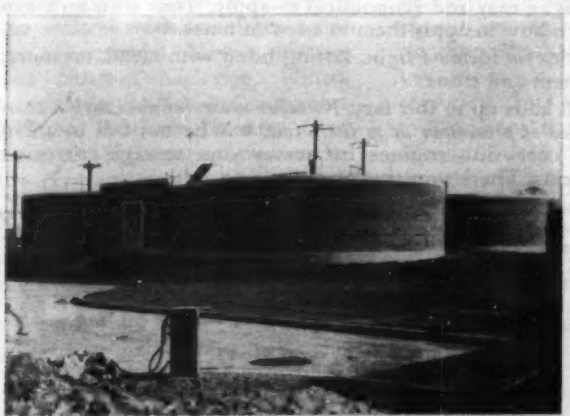
The control chamber is ideally housed . . . surrounded by the four 55-foot digesters. *P.F.T. Cover Position Indicator Dials* (with low-level alarms) flank each side of the room. An operator may see the exact position of the *P.F.T. Floating Covers* on his tanks at a glance. He may keep close control of supernatant liquor by means of the *P.F.T. Supernatant Selectors and Gauge Glass* located just below the indicators.

Ample space is provided in the control room for convenience in operation of the digester system.

The gas-fired *P.F.T. Heater and Heat Exchanger* (at left) has a capacity of 750,000 Btu per hour. The other unit (at right) is gas and oil fired with a 500,000 Btu per hour capacity. The entire plant incorporates the latest thinking in plant and control room design.

Modern safety features include these P.F.T. Gas Safety Units—two 3-inch waste gas burners; four 3-inch pressure relief units; four 3-inch low-pressure checks; four 3-inch sediment traps and accumulators; flame cells; manometers and drip taps. The gas safety equipment is located in a separate room.

Complete information on all or part of Levittown's equipment is yours upon request.



Outside view of the four 55-foot digesters showing the convenient position of the control room.

Design of plant by / *Albright & Friel, Inc., Philadelphia, Pa.*

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

4241 Ravenswood Avenue
Chicago 13, Illinois

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

Here's how you can stop Sewage Corrosion before it starts!

Corrosive acids, alkalis and salts won't ever get a chance to eat up this sewage settling tank! It's being coated with *Pitt Chem* 103—the coal tar coating that stands up to punishment no ordinary paint can handle.

Pitt Chem Cold Applied Coatings give you three unique advantages:

1. They out-last ordinary paints by many times. Yet they cost no more per gallon.
2. They're easy and economical to apply. Your own men can learn how to apply them in a few minutes.
3. *Pitt Chem* forms a tight, lasting bond with metal, masonry, cement and stone.

It all adds up to this fact: *No other material does such a complete job of protection at so little cost.* ● Why not call in a Pitt Chem corrosion engineer to survey your sewage corrosion problems. There's no cost or obligation.

WAD 5046

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
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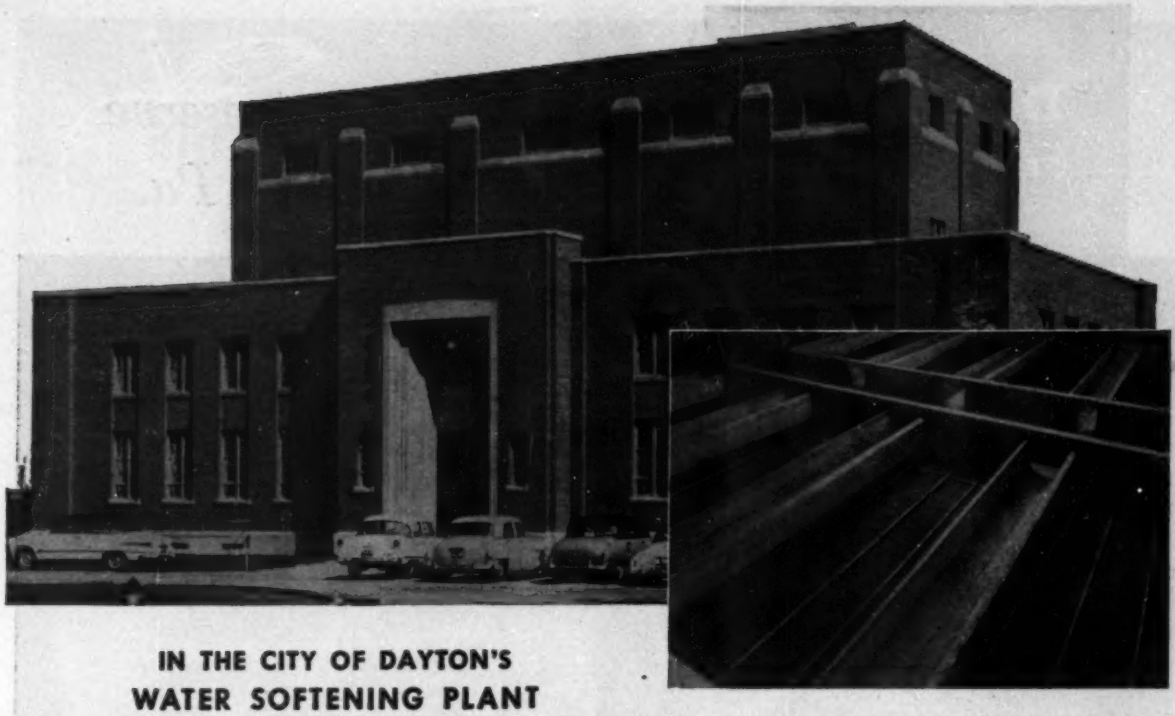


IN THE CITY OF DAYTON'S
WATER SOFTENING PLANT

WROUGHT IRON PIPE helps assure *long-life service... minimum maintenance*

Realizing that more than 240,000 people would depend daily on the uninterrupted service of this million-and-half dollar water softening plant, the designers took decisive steps to assure maximum protection against corrosion. In all wash water lines and process piping, 3-inch and smaller, wrought iron pipe was installed. The insert illustration above shows a portion of the surface wash water piping on the filter beds. Alvord, Burdick and Howson, Chicago, Illinois, were the architects and engineers. Johnson Brothers Heating Company, also of Chicago, was awarded the contract for the piping work.

Every engineer will recognize the corrosion hazard that is present in each of these services. And many engineers, from all sections of the country, can certify from personal experience how effective wrought iron pipe is in combating the conditions. In hundreds of reported installations, wrought iron pipe has doubled, tripled and even quadrupled the useful life previously obtained from low-first-cost piping materials.

The best guide in applying wrought iron pipe is not just a list of current uses, but an understanding of what wrought iron is, how it's made, and why it resists corrosion. This story is condensed in our booklet, *"The ABC's of Wrought Iron."* We'll be happy to send you a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N.Y.

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glasslike silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

DE LAVAL CENTRIFUGAL PUMPS *bring 68% water reserve to Allentown, Pa.*

These 15 mgd, 288 foot-head centrifugal pumps are among the total of nine De Laval units that provide a new, all-time high in water availability at Allentown, Pa. Full capacity is 42 mgd, present consumption 25 mgd — a "cushion" of 68% against the heavier demands of future years.

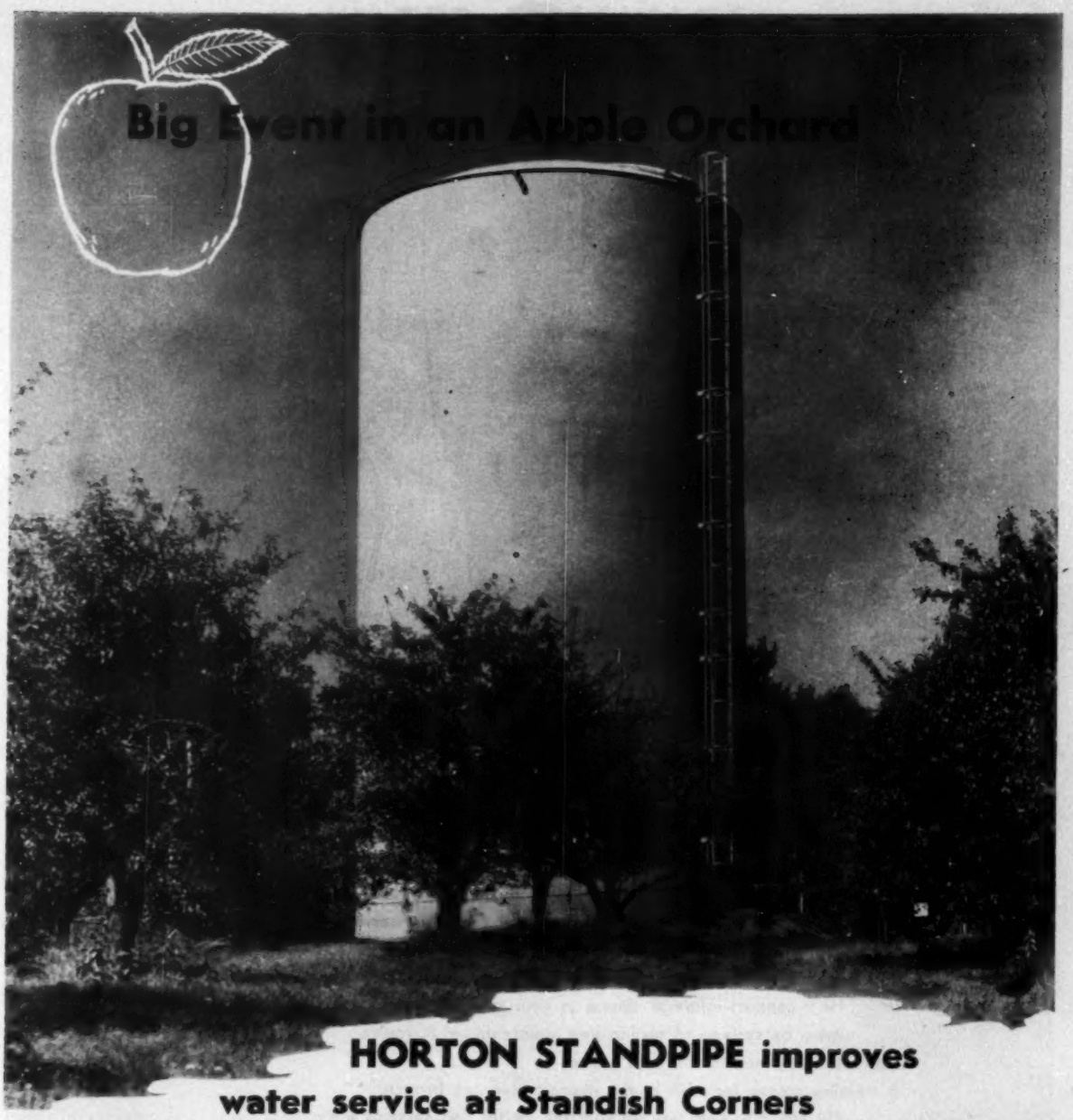
Part of the problem in setting up this big, new facility was to utilize as much equipment as possible from the old plant. Here, De Laval versatility paid off, for several units which had already been in use for twenty years tied in easily, economically, with the new system.

More than 80% of America's cities look to De Laval for the utmost in pump performance and dependability. And they profit daily from De Laval's fifty three years of experience in municipal water works pumping. De Laval units range in capacity from 100 thousand to 100 million gallons per day.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
824 Nottingham Way, Trenton 2, New Jersey

DL 279



HORTON STANDPIPE improves water service at Standish Corners

Deep in an orchard, this 500,000-gal. Horton® standpipe is an important part of the Portland Water District water system at Standish Corners, Maine. In a district where the Summer population is many times what it is in Winter, it is necessary that precautions be taken to provide efficient water service during peak load periods. This 35-ft. by 70-ft. high Horton standpipe is Portland Water District's answer to the sudden influx of vacationers that yearly tax its system.

Horton standpipes and reservoirs are built in standard capacities up to 10,000,000 gallons in accordance with AWWA specifications. Horton elevated tanks are built in sizes from 5,000 to 3,000,000 gallons. Write our nearest office for further information, estimates or quotations.

HORTON

WELDED STEEL

STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3	2181 Healey Bldg.	Los Angeles 17	1555 General Petroleum Bldg.
Birmingham 1	1506 North Fiftieth St.	New York 6	3310—165 Broadway Bldg.
Boston 16	1040—201 Devonshire St.	Philadelphia 3	1644—1700 Walnut Street Bldg.
Chicago 4	2190 McCormick Bldg.	Pittsburgh 19	3240 Alcoa Bldg.
Cleveland 15	2262 Midland Bldg.	Salt Lake City 4	550 West 17th South St.
Detroit 26	1551 Lafayette Bldg.	San Francisco 4	1503—200 Bush St.
Havana	402 Abreu Bldg.	Seattle 1	1530 Henry Bldg.
Houston 2	2115 C. & I. Life Bldg.	Tulsa 3	1646 Hunt Bldg.

THE MEANING OF SERVICE

Customer service is an important job for any manufacturer who makes a product that stays in use for a long time. It's especially important for Trident meters, many of which have been known to last 50 years and more.

That's why Neptune decided many years ago that the best way to sell more water meters . . . was to help you get better service from the ones you have.

Your Neptune salesman is a trained expert on meter repairs and metering practice. He's anxious to pass this knowledge along to you.

He'll conduct informal classes in your shops . . . demonstrate new wrinkles . . . advise on systems of testing and maintenance. If you've inexperienced men to train, he'll arrange a training course for them at the nearest Neptune branch.

His job is to help you do your job better. His services are yours for the asking. Please don't hesitate to ask.

NEPTUNE METER COMPANY
50 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario

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neptune

WATER & SEWAGE WORKS

VOL. 101, NO. 3 MARCH 1954

FILTER gallery of the new Dayton, Ohio, water softening plant

Dayton's New Treatment Plant

Largest U.S. well water softening and iron removal installation

by VERNON R. KNEER, *Resident Engr., Alvord, Burdick & Howson, Chicago, Illinois*

THE Department of Water of Dayton, Ohio, recently placed in operation the largest well water softening and iron removal plant in the U.S. Construction costs for the 96 mgd plant amounted to $4,139,732, or approximately $43,000 per million gallons of rated capacity This comparatively low cost figure results largely from the nature and simplicity of the flow diagram, the compact design, and the use of the basins as conduits. Due to the existence of a 5.4 mg reservoir which could be used for clear water storage, only an additional 5.0 mg of clear water capacity was included; thus reducing the cost of clear water storage for the new plant by about $250,000.

The $4,139,732 cost covers the capital outlay for a plant that is attractive, complete in all respects, and adequate in design and capacity. Further, the materials of construction selected are those having long life and low maintenance costs.

This installation, recommended by a Citizens' Water Advisory committee in 1950, marks another step forward in the treatment and improvement of one of the nation's largest underground supplies. Dayton is one of the important cities of this country which still depends on ground water supply, although in doing so it practices artificial recharge to an important extent. Favorable natural conditions for groundwater development, together with the foresight and the ingenuity that have directed that development, have given Day-

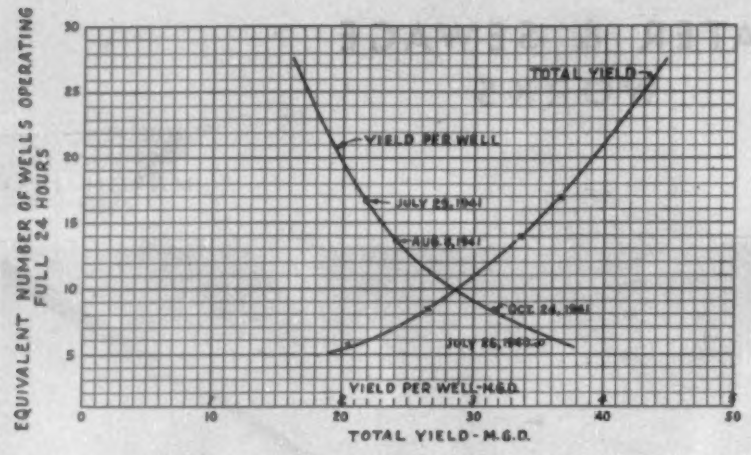


Fig. 1—NUMBER of wells operating related to water yield, Dayton, Ohio
Based on 1941 flooding facilities.

ton an underground supply adequate for a long period in the future.

Dayton is located in a region of moraines and gravel plains deposited by the southward moving glaciers in the ice ages. Fortunately, for water supply purposes, the coarser sands and gravels were deposited above the city in more or less horizontal beds, having relatively shallow cover, and being of considerable thickness. The city itself is located at the confluence of two moderately large streams, in whose valleys are found extensive gravel deposits containing large quantities of water and capable of supporting high sustained drafts. The Mad River, along whose banks the Dayton supply is taken, has the highest sustained flow of any stream in Ohio.

Early Water Supplies

It was largely because of the comparative ease of securing individual well supplies that the City of Dayton grew to a population of approximately 31,000, by the year of 1870, before there was a public water supply. Water was obtained first from springs and streams, then individual wells, and later from centrally located public wells. In 1869, the people voted for a public water supply; in 1870, the municipally owned water works supplied its first customers.

The first well, 25 feet in diameter and 15 feet deep, located on the south side of the Mad River, near the present water works, proved inadequate within the first year. It was then augmented by infiltration from horizontal collecting galleries, by raw river water, by an additional 18-foot well, and by water pumped from private wells located nearby.

In the year 1886, it became obvious that other methods of obtaining water must be found and developed.

From 1886 to 1910, ninety-four 8-inch tubular wells, 30 feet to 88 feet in depth, were sunk between the levees of the Mad River near the present pumping station. These "river wells" collectively pumped, yielded about 10 mgd. In 1910, a group of six 8-inch wells, sunk east of the main group, and known as the "aqueduct wells," yielded another 1 mgd. Between 1914 and 1919, first 28 and then 11 additional 8-inch wells were drilled farther east, and about two miles upstream from the Ottawa Street pumping station, in the Tate's Hill area. These wells delivered another 5 mgd through an independent 36-inch cast iron main leading from Tate's Hill to the main pumping station. All of the above supplies were obtained from the shallow, water bearing gravel deposits along the Mad River.

In 1924, an underground receiving or suction reservoir of 5.4 mg capacity was built just east of the main pumping station on Ottawa Street.

Rohrer's Island Development

During 1924, an extensive investigation was begun for the purpose of developing data required to locate future underground water resources. More than 150 test wells were drilled along both sides of the Mad River, from the area just east of the Tate's Hill wells to the Huffman Dam about 3 miles upstream.

As a result of the investigation, it was decided that this upper Mad River area, known as Rohrer's Island, some 2½ miles long by ½ mile wide, offered the most practical site for additional groundwater supply development. It was also decided to develop this field through the installation of a small number of relatively large diameter wells, each equipped with an electrically driven, deep well turbine pump. The individual pumps discharge into branch lines, all of which are connected to a reinforced concrete conduit (increasing in diameter from 54 to 84 inches) which delivers water to the suction reservoir and pumping station.

Up to the present time, 33 of these shallow wells, ranging from 69 feet to 78 feet in depth, have been sunk through the gravel to the clay stratum which averages 25 to 50 feet in thickness at this location. An additional 10 wells, averaging 168 feet in depth, have been drilled through this clay stratum. These deeper wells are copious producers but carry so much iron as to be objectionable unless treated for its removal.

The aggregate capacity of all these wells is approximately 120 mgd. However, due to mutual interference, the actual maximum yield, if all were pumped simultaneously, would probably not exceed 70 mgd, and to sustain that yield, land flooding would be required (Fig. 1). The present water supply is obtained almost entirely from these wells located on Rohrer's Island, with the Tate's Hill group available for emergencies.

Land Flooding Practice

The development of the Rohrer's Island well field, under the direction of Wallace W. Morehouse, was a major step toward providing for an adequate supply capable of expansion for many years. However, to

Table 1
Typical Analysis of Raw Water, Dayton, Ohio

Well No.	Calcium	Magnesium	Hardness			Iron	pH
			Temporary	Permanent	Total		
Aqueduct	88	36	290	77	367	0.00	7.4
Mad River	88	35	290	73	363	0.00	7.3
24	87	26	270	54	324	0.00	7.3
18	94	32	280	86	366	0.70	7.3
11	91	32	295	60	355	0.00	7.3
30	94	31	284	76	360	0.20	7.8
10	90	34	325	36	361	0.15	7.3
Average	93	35	287	84	371	0.09	7.3

AIR VIEW of Dayton's plant. (Left) Flocculator channel and coagulation basin with Monorake sludge removal equipment. (Right) Chemical building and railroad siding

meet the demands brought about by the unprecedented expansion during World War II, replenishment through flooding was tried in order to supply more water to the underlying gravel, and to decrease the pumping head. From the viewpoint of water quantity, flooding was successful.

Observations made after cleaning the surface beds indicated the ability of the beds to pass about 1.7 mgd per acre into the subsoil. With this high rate of absorption, it is quite probable that the entire dry weather flow of the Mad River could be diverted into the underlying gravel by utilizing sufficient flooding surface.

Land flooding is not new. Another large installation with which the writer is familiar is at Des Moines, Iowa. At Des Moines, where the gravel in the beds has an average effective size of .42 mm—an ideal average for proper filtration—the rate of absorption into the basins after cleaning is approximately 1.0 mgd per acre. The surface gravel at Dayton generally is coarser than that at Des Moines.

Dayton enjoys a natural operating advantage over Des Moines, and makes excellent use of it. At Des Moines, water must be pumped from the Raccoon River into the flooding basins; at Dayton, the relatively steep slope of the river bed and the relatively low banks permit flooding by ingenious dams. All flow through basins and channel is by gravity. The relatively steep slope of the river bed also results in higher velocities, with less sedimentation of fine silt and less clogging of the river bed. However, at times, both cities resort to scarifying the channels. Scouring floods seldom come when needed.

Dayton Supply Becomes Potentially Hazardous

Because of the coarse gravel and the high rates of filtration through the gravel, particularly after cleaning the beds and channels, and because of the location of wells in close proximity to the river, there was little purification of water at Rohrer's Island other than the removal of silt. Furthermore, because of the elevation of the hydraulic gradient, the 84-inch concrete conduit connecting the wells to the suction reservoir functioned as a gravity conduit rather than a pressure conduit. With dependence placed entirely upon chlorination, the source of supply became potentially hazardous. The supply obviously could be made safe if the water received filtration or softening treatment in addition to chlorination. These views were summarized in a report by the State Department of Health titled, "Detailed Investigation of the Public Water Supply at Dayton, May, 1937."

Six years of discussion and investigation followed the submission of the report by the State Health Department. In 1943, the firm of Alvord, Burdick and Howson, Engineers, was requested to examine and study the existing water supply facilities and "to report on the most practical means of enlarging them, and the best means of eliminating potential hazards so as to make the supply acceptable from all standpoints." In short, the study was to embrace problems both of quantity and quality.

Briefly, the firm's report recommended: 1. More extensive flooding areas on Rohrer's Island as the most practical method of enlargement, with immediate enlargement of areas up to 50 acres for drafts of 60 mgd, capable of ultimate enlargement to 75 acres; and, 2. The construction of a 72-mgd softening plant that would automatically remove the contamination hazard and the objectionable iron content in the water.

Purification Only or Purification With Softening

Purification could have been accomplished in a water filtration plant without employing softening. However, Dayton's water is excessively hard, averaging about 365 ppm, thus resulting in expenditures by consumers for softening which are far out of proportion to the cost of softening in a municipal plant.

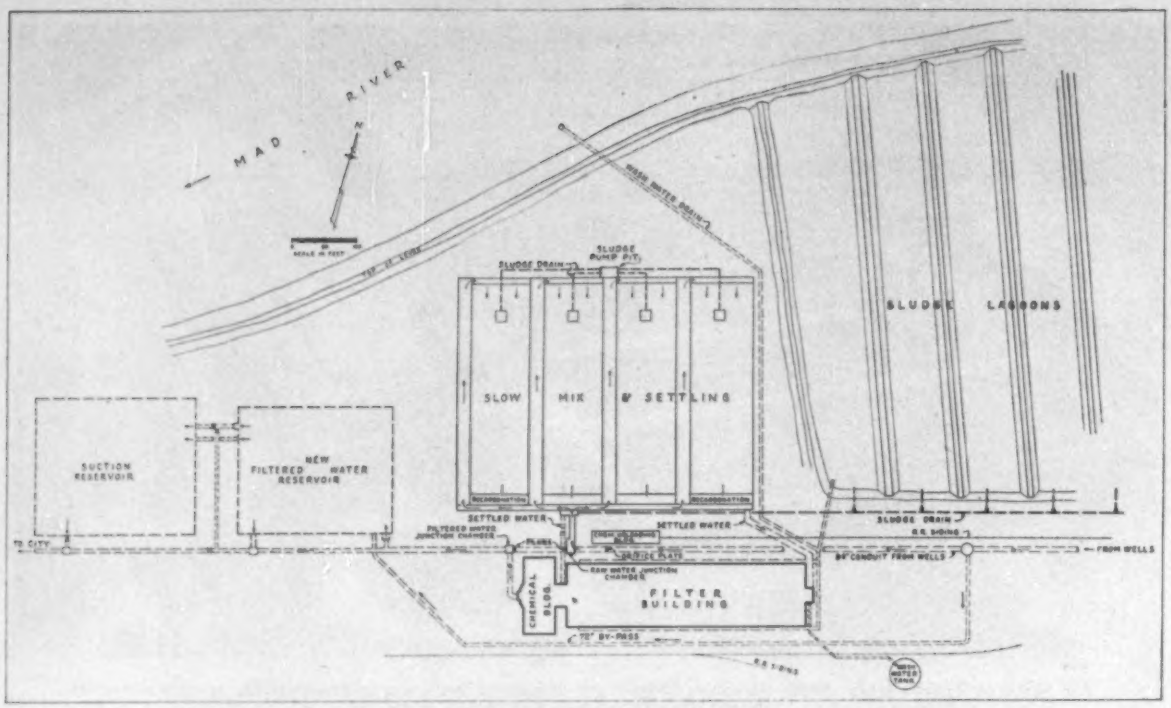


Fig. 2—PLAN view of Dayton's softening plant units. Broken lines show new water mains.

In general, as shown in Table 1, the sulfate hardness averages less than 25 per cent of the total hardness. Recent analyses by E. B. Evans, Superintendent of Water Treatment, indicate that the deeper wells which penetrate through the clay stratum run considerably lower in sulfate hardness than the shallow wells but, as previously stated, water from the deeper wells has a high iron content. There is little difference in chemical characteristics between the river water and the water from the shallow wells.

A softening plant of the conventional lime-soda ash type, which was estimated to be most economical for treatment of Dayton water, is essentially a filtration plant with a few additions. The additions include more liberal provisions for chemical storage, additional chemical handling and feeding equipment, and the installation of mechanical sludge removal equipment in the settling basins. The construction cost of these additions is approximately 15 per cent above the cost of those units required for filtration alone.

Although the primary reason for installing water treatment at Dayton was to remove the health hazard, water softening was reported as also being a good investment for the city. The resulting savings far outweigh the cost, particularly since softening could be installed in conjunction with filtration. Direct benefits from softening, on soap savings alone, based on a reduction in hardness of 285 ppm, are estimated to be $3.30 per capita per year. Applied to Dayton and the surrounding territory served, this figure is equivalent to an annual saving of $910,000. Other benefits, more difficult to evaluate, include decreased maintenance costs of furnace coils, water heaters and automobile radiators; the elimination of cisterns, and of double plumbing and operating costs for water softeners; the savings produced by longer life for clothing and laundered fabrics, the reductions in operating costs in generating steam and hot water, and other incidental or indirect savings that would greatly add to the soap saving previously quoted. All the savings together are believed to amount to more than three times the cost of softening. Hard water may be cheap to buy, but it is costly to use.

Because of these recognized benefits, a combined water purification and softening plant was included, in 1945, as a part of a "Ten Year Program of Capital Improvements for Dayton." Such vision and judicious long range planning is characteristic of city administration in Dayton, and is in accord with the farsighted policies that prompted earlier leaders, after the disastrous 1913 flood, to investigate thoroughly, to appraise the benefits, and then to build adequate protection works. The cost of the works was far below the return from resultant benefits.

The sharp increase in building costs that followed World War II discouraged construction of the softening plant at that time. However, in September, 1950, shortly after the outbreak of hostilities in Korea, a Citizens' Water Advisory Committee recommended immediate construction. Revenue bonds were issued early in 1951.

Basic Plant Design

Almost ten years had passed since making the studies on which the proposed plant requirements had been based. During those ten years, the average daily pumpage had increased from 27 mgd in 1942 to 43 mgd in 1952. The maximum day pumpage had increased from 37 to 67 mgd. A softening plant must be capable of meeting the demand of the maximum day's pumpage. The 72 mgd plant, proposed in 1943, had been tailored for 1960 requirements. By 1951 that date was but 9 years distant, and present pumpages were exceeding the forecasts, largely because of the unprecedented expansion at Dayton during and following World War II.

A municipal water softening plant represents construction of a permanent nature, not frequently under-

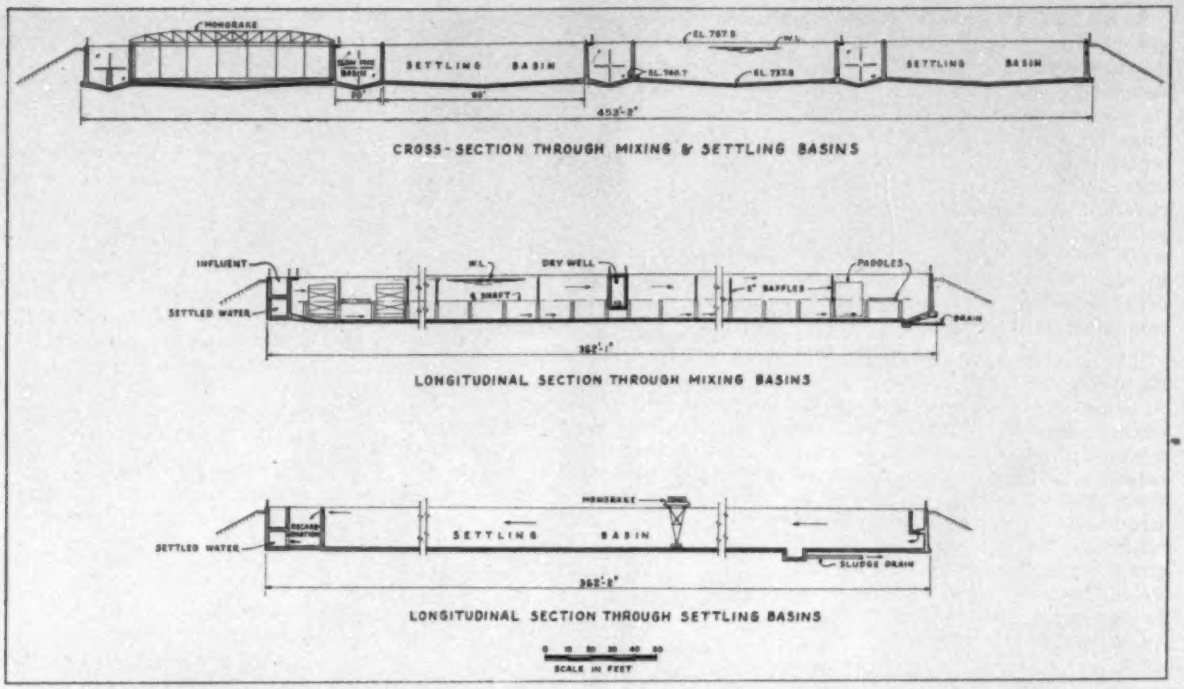


Fig. 3—SECTION views of mixing and settling basins, with details and dimensions of the Dayton plant

taken. Water works must necessarily be designed to meet future needs, and construction programs should be planned ahead for at least two decades.

With these considerations in mind, the original plans for the Dayton plant were revised. When bids were taken in February, 1951, they were based on a plant capacity of 96 mgd, estimated to meet the city's requirements for another twenty-five years. The revisions incorporated the latest advancements that had become available in the treatment of water since 1943.

In the plant design, consideration was given to the use of zeolite filters, alone or in conjunction with lime treatment and filtration, and to the lime-soda method using contact type basin precipitation processes. It was decided that the conventional lime-soda treatment was best adapted for the Dayton supply.

Because the groundwater supply was naturally low in bacteria, the rate of filtration could be increased from 2 gal. per square foot per minute, standard for surface supply filtration, to 3 gal. per square foot per minute. Filter beds were designed, therefore, with a sand area for 64 mgd, under standard practice; while all hydraulic design of the plant, including filters and the mixing and settling basins, was based on a capacity of 96 mgd.

Rate controllers and hydraulic passages were liberally designed, so that the plant can be operated at rates 25 per cent in excess of 96 mgd. The practicability of utilizing the existing 5.4 mg suction reservoir as part of the clear water storage, the location of the high service pumping station, and the layout of feeder mains influenced the location of the plant site and the determination of flow lines.

The new work is shown in a plan, Fig. 2. It includes:

1. 72-inch raw water by-pass line for use during the construction period.
2. Mixing, settling, and recarbonating basins (17 mg capacity).
3. Filter Building (96 mgd rate).
4. Chemical building with storage bins, pneumatic chemical handling equipment, chemical feed machines, laboratory and offices.
5. Chemical unloading building with storage bins and railroad siding.
6. Filtered water reservoir (5 mg capacity).
7. Wash water tank (200,000 gal. capacity) and wash water pumps.
8. Sludge lagoons (16 acres).

Construction Procedure

As shown in Fig. 2, it was necessary to make four cuts into the existing 84-inch raw water conduit for connections to the new work. The first of these cuts or junction chambers was for diversion of the raw water to the mixing basins, the second received the treated water from the plant, the third and fourth served as inlets and outlets for the new filtered water reservoir. Two permanent concrete plugs were placed between the first and second connections, to separate the treated and untreated supplies. An orifice plate for measuring the quantity of raw water was installed ahead of the raw water junction chamber.

The time required for making any of these connections was longer than could safely be allowed for keeping the conduit out of service. One of the first jobs, therefore, was to lay about 1,100 feet of 72-inch concrete pressure pipe as a by-pass conduit for re-routing the raw water supply around the new work. This was done so that the section of 84-inch conduit between the by-pass connection and the existing suction reservoir could be isolated and taken out of service. The 72-inch by-pass line remains for emergency use.

Treatment Practice

With the new plant in operation, the well supply from Rohrer's Island is pumped through collecting lines into the 84-inch conduit which discharges into the raw water junction chamber. From this point, flow through the plant is by gravity. A section view of the settling basins is shown in Fig. 3.

Soda ash, and alum if needed, can be applied independently near the upstream end of the hopper-bottomed junction chamber. Up to the present, alum has not been used. Lime is added in a second hopper-bottomed depression in the raw water duct, just beyond the junction chamber. Pressure lines with nozzles, and a blow-off connection to the wash water drain have been installed in each of the hopper bottoms in order to break up and remove any accumulation of sludge or grit.

The preliminary quick mixing of chemicals that takes place in the junction chamber and raw water duct is followed by slow mixing for a period of 45 minutes, at rated plant capacity, in four basins. Each of these slow mixing basins, 349 feet in length and 20 feet wide, is equipped with one row of horizontal shaft, paddle type flocculators having two drives housed in a dry-well midway in each basin. These flocculators have variable speed drive.

From the mixing basins, water flows into a distribution trough extending the width of the settling basins, and then through adjustable slotted openings in the bottom of the trough into the settling basins. The detention period in these four basins is 3.2 hours at the rated plant capacity of 96 mgd. Sludge is removed from the four basins by bridge type, single unit Monorakes, which collect lect and deliver it to a sump located 59 feet from the inlet end of each basin.

From each sump, it flows by gravity through an electrically operated gate valve into a wet well in the sludge pump pit. The Monorake automatically opens and closes an electric drain valve as it travels the length of the basin. Three float-controlled electrically driven centrifugal pumps discharge the sludge from the wet well to the drying lagoons. Provision has been made for returning all or part of the sludge to the raw water duct.

Since the sludge flows to the sludge pump suction well in four separate pipes of varying length, and since the sludge will vary in density, it is important that only one sludge line from one basin be open to the pump sump at a time. Accordingly, electrical controls are provided to prevent any two of the four sludge Monorakes from synchronizing. All four units are interconnected electrically, to assure uniform withdrawal of sludge from all basins in proper sequence.

All four mixing and settling basins can be operated in parallel; or they can be operated in duplicate, with two units in series. Each of the slow mixing basins is 20 feet by 349 feet in size, with an average wall depth of 17 feet 9 inches; the settling basins are 90 feet by 326 feet, with a wall height of 17 feet 9 inches. The basins are of open top, reinforced concrete construction, without expansion joints.

The effluent from the settling basins passes through a recarbonation basin and then to the sixteen 6 mgd filters. Recarbonation is provided either by underwater combustion at the outlet of each recarbonation basin, or by an auxiliary supply in two basins; the latter consists of a diffuser grid system which disperses boiler flue gas into the settled water.

In the submerged burners, a mixture of natural gas and air, under 15 psi pressure, is ignited underwater by an electrically heated coil. Gas and air delivered independently by electrically driven compressors are united and mixed just above the burners; the rate of flow is regulated by automatic control. Each of the four burners has a capacity for producing 3,000 to 6,000 pounds of carbon dioxide per twenty-four hours. Water sprays, provided at each burner for better diffusion, result in higher CO_2 absorption by the settled water.

The plant design utilizes basins as flow channels and thus practically eliminates large and costly conduits. After the water has received its chemical dosage, the 350-foot long flocculator basin conveys the treated water to the inlet end of the settling basin. The settling basin, in turn, serves as a conduit to bring the flow back to a point immediately adjoining the filters.

Chemical Feeding and Handling Equipment

Chemical feeding equipment consists of two lime feeders and slakers, two soda ash feeders, two alum feeders, one sodium hexametaphosphate feeder, and two chlorinators. The lime, soda ash, and alum feeders are of the gravimetric type having a belt feed supported on scales. The lime feeding units have a capacity of 100 to 10,000 pounds per hour, the soda ash units 25 to 2,500 pounds, and the alum machine 10 to 1,000 pounds. The chlorinators have a range of 50 to 350 pounds per 24 hours. The sodium hexametaphosphate feeder is of the solution feed batch type, having a range of ½ to 50 gallons per hour. The water supply to the lime slakers and soda ash feeders is preheated, and is blended by automatic thermostat control.

The chemical feeders are located on the second floor of the chemical building. The solution lines, all compartatively short, carry the flow to points of application by gravity. The lime, soda ash and alum feeders are served by overhead steel storage bins extending to the fourth floor of the building. Hand-operated rotary gates are attached to the bottom outlet of the bins. Bulk shipments of the chemicals, by railroad cars or by truck, are delivered to the chemcial unloading building. Here they either can be dumped into underground hoppers of 400 tons capacity, or delivered to the storage bins in the chemical building by a pneumatic conveyor of the combined, vacuum-pressure type. Materials delivered to the receiver on the upper floor of the chemical building by the pneumatic conveyor are blown through a "switch" hose to any one of the five active bins serving the feed machines, or to two dead storage bins.

A monorail hoist was installed to handle ton containers of chlorine. Storage space for chlorine cylinders has been provided on the first floor. The chlorine cylinder storage space and the room above, housing the chlorinators, are isolated from the remainder of the chemical building

Table 2
SUMMARY OF CONSTRUCTION COSTS, DAYTON, OHIO

Item	Contractor	Amount
Structures	The S. N. Nielson Co.	$3,013,408
Filter Equipment	Bass Eng. & Const. Co.	742,846
Chemical Bins, Wash Tank	Chicago Bridge & Iron Co.	91,800
Pneumatic Conveyor	Brady Conveyors Corp.	25,739
Mixing & Settling Basin Equipment	The Dorr Co.	172,687
		$4,046,480
Sludge Lagoons	Work Done by City	$ 30,300
Railroad Siding	"	22,952
Landscaping and Drives (Estimated)	"	40,000
		$ 93,252
Total Construction Costs		$4,139,732

[Note: Total construction costs are equivalent to a cost of $43,122 per mgd of plant capacity.]

PIPE gallery of the Dayton water softening plant

and are equipped with fan and blower for exhausting any escaping chlorine fumes.

The Filter Plant

The settled water flows from the recarbonation basins to either end of the influent conduit which extends the entire length of the filter building. The 16 filters, each with a sand area of 1,390 square feet, have a combined rate of 96 mgd when operated at 3 gal. per square foot per minute. The filter media consists of 29 inches of gravel, ranging in size from 2½ inch to ⅛ inch; and of 22 inches of sand, having an effective size of .40 to .50 mm. Underdrains are 4-inch cast iron laterals spaced 9 inches apart with 7/16-inch openings on 6-inch centers.

Alternate bids were taken on Wheeler and on Leopold bottoms. The lowest bidder asked $40,000 additional for the Wheeler bottoms, which was the second lowest bid. His bid was slightly higher for the Leopold bottom.

The filters are equipped with the fixed-jet type surface wash system hung from precast concrete wash troughs. All valves are hydraulically operated from built-in operating tables. Master control of filters by water level in the influent channel has been provided in addition to hand control. Controls and gauges are air operated.

Wash water from the filters can be discharged directly into the river, or can be settled in an earthen basin so that only the supernatant is discharged to the river. Wash water for the filters is drawn from the filtered water conduit by two 3,500 gpm electrically driven, vertical shaft, well turbine type pumps; and is discharged into a 200,000-gal. wash water storage tank located outside the building.

During filter washing, when the water level in the storage tank drops 2 feet, a water level control starts the pumps and delivers wash water in two ways, i.e., both from the tank and directly from the pumps. The pumps continue operating until the tank has been refilled. They then are stopped by the same water level control. Filters normally are washed at about a 24-inch vertical rise, although hydraulic design of troughs and piping is based upon a 30-in. rise. The underground water exhibits relatively small temperature variation.

Chlorine and sodium hexametaphosphate solutions are applied to the filter effluent in that portion of the filtered water conduit which is within the chemical building. An illuminated observation port, or sight well, was installed in this portion of the conduit.

From the filtered water conduit, the effluent is discharged to the new 5 mg capacity reservoir and then to the old suction reservoir from which it is pumped into the distribution system. The new clear water reservoir and the old suction reservoir were so valved that they can be operated together (the normal practice), or so that each can be isolated and operated independently.

The new reservoir is of reinforced concrete construction, box type, having a flat slab roof and floor, approximately 240 by 195 by 15 feet in size. It has no expansion joints. The concrete sides and top are protected by earth cover to minimize temperature stresses.

When bids on the plant were taken, alternatives were requested on a number of items. One of the most

important items was that relating to the use of ceramic tile versus terra cotta in the filter operating gallery and main entrance sections of the plant. The successful contractor quoted $45,000 higher on terra cotta. On account of the desirability of the larger block terra cotta tile, as compared to the smaller ceramic tile blocks, further investigation was made with respect to this item.

It developed that $30,000 of the $45,000 could be saved if it were practicable to utilize patterns and molds already on hand in the terra cotta company's plant, rather than to adhere strictly to the details of the architectural design. Careful study of the available molds, and selection therefrom, made it practicable to secure at a saving of $30,000. Substantially the same results would have been secured by strict adherence to architectural details. The additional cost for terra cotta over ceramic tile was thereby reduced to $15,000, an amount believed justified.

The pleasing appearance of the filter gallery is illustrated in Fig. 3. The floor of this gallery is of varigated colored quarry tile; the roof is of reinforced concrete with a slightly arched surface. Daylight illumination is provided through glass block windows.

Alternate proposals were taken on the cost of exterior facing of Indiana limestone as compared to face brick. Although the limestone would cost only $10,000 more, the decision was made to use face brick with stone trim and copings.

Some substantial savings were made after acceptance of bids. Original plans called for a one-inch "skin coat" of Class "B" concrete under all water-containing structures. Such a lining over the subgrade gives clean, solid support for top and bottom reinforcing steel and metal chairs; and it proves a firm, dry foundation for the concrete slab itself, with greater assurance of uniform thickness and effective depth. Ordinarily the "skin coat" is a wise investment. However, when the excavation at the reservoir site had been completed and the subgrade uncovered, it developed that the exposed gravel contained just about the right amount of fines to provide a firm, hard, and well-drained surface, not unlike that of a good gravel road, and almost the equal of a subgrade with a 1-in. concrete lining. Advantage was taken of this natural condition, and the "skin coat" omitted at a saving of $27,000.

MATERIALS AND EQUIPMENT SUPPLIERS
WATER PURIFICATION AND SOFTENING PLANT, DAYTON, OHIO

Filter Equipment	
Chemical Feeding Equipment	Omega-Builders Providence Inc.
Meters, Controllers, Gages, and Operating Table Equipment	Builders-Providence Inc.
Carbon Dioxide Equipment	Ozark-Mahoning Company
Chlorinators	Wallace & Tiernan
Check and Gate Valves	A. P. Smith Mfg. Company
Sluice Gates	Rodney Hunt Machine Company
Wash Water Pumps	Fairbanks-Morse & Company
Precast Wash Troughs	Price Brothers Company
Filter Sand and Gravel	Northern Gravel Company
Cast Iron Piping	U. S. Pipe & Foundry Company
Small Valves and Piping	Crane Company
Wash Water Tank Level Controls	Automatic Control Company
Blowers	Roots-Connersville
Underwater Paint	Inertol Company Inc.
Structures and Outside Piping	
Mechanical Work	Johnson Brothers Heating Co.
Electrical Work	Dooley-St. Arnaud Company
Concrete Pressure Pipe	Price Brothers Company
Laboratory Fixtures	Laboratory Furniture Company
Terra Cotta	Northwestern Terra Cotta Corp.
Elevator	Capital Elevator & Mfg. Co.
Precast Concrete Roof	The Geo. Rackle & Sons Co.
Metal Windows	Truscon Steel Company

Adjustments in the construction cost of the settling basins, after the award of the equipment contract to the low bidder, resulted in a net savings of $23,742. This saving was largely in concrete, reinforcing steel, and formwork. Another credit of $9,950 resulted from the omission of Puzzolith in the concrete mix when uncertainties in the deliveries of standard Portland cement dictated the selection of air-entrained cement.

Construction and Costs

Bids for most of the work were taken on February 28, 1951, and contracts were awarded on April 28, 1951. Bids for the railroad siding were taken and contracts were awarded during November, 1952. Construction of the earth levees for the sludge lagoons, paving, and landscaping were jobs done by the City's own forces.

The individual contracts are summarized in Table 2. The total of all contracts let on April 28 amounted to $4,140,026. Extras on all contracts were less than the credits taken. The final construction costs on these same contracts total $4,046,480, reflecting a net savings of $93,546.

Work was started in May, 1951. The plant was placed in service in May, 1953, under the supervision of Edmund B. Evans, Superintendant of Water Purification. By the end of 1953, all contracts were completed with the exception of the chemical handling and conveying equipment. Alvord, Burdick & Howson prepared plans and supervised construction. They were represented in the field by Philip G. Odgers and the writer.

The Department of Water, established by the City Commission in 1926, operates the water utility, the sewage treatment plant, and the sewerage system. Its present Director is Lloyd C. Huffman. Herbert W. Starick is City Manager. Members of the City Commission, during construction of the plant, were Louis W. Lohrey, Mayor, Merle P. Smith, John C. Csipkar, Jack D. Reeder and Howard Malone.

With the installation of the new facilities at Dayton, the City Commission has met the basic requirements of any water supply: an abundance of safe, clear, sparkling, and palatable water. In addition, by including softening as a part of the treatment process, it has kept pace with today's rising standards of quality. Water softening more than pays its own way, and adds another municipal service that will contribute much to Dayton's welfare.

WATER WORKS PRACTICES

Source of Supply--Part 6

Well Pollution, Operation, Maintenance

The Tenth of a Series

by **GEORGE E. SYMONS, *Ph.D., Consultant & Technical Editor, Larchmont, N. Y.***

THIS lecture completes the subject of "Source of Supply", which included one lecture each on Surface Water, Ground Water and Impounding Reservoirs and three lectures on Wells (Location and Construction; Capacity and Development; and Pollution, Operation and Maintenance).

This article is one of a series on the general subject of "Water Works Practices," developed by Dr. Symons in the simple style of a short course lecture and designed to be of interest to small plant operators, new operators, students and many others who may wish to review the fundamentals of the subject.—*The Editors*

A . . . Pollution

1. . General

a. Pollution may include sewage, industrial waste, garbage and ashes, and salt water; its travel is most rapid and greatest in the direction of ground water flow.

b. Coliform bacteria quickly reach the maximum distance of travel of about 100 ft. This distance will depend on the type of soil.

c. The number of bacteria is rapidly reduced as the pollution travels underground through the soil, but this reduction, too, depends on the type of soil encountered.

d. Pollution may clog underground water bearing strata both from suspended solids and by ion exchange, if such reaction takes place.

2. . Sewage

a. In a very few localities, sewage has been discharged into wells as a means of disposal and has reached underground water supplies. The practice is definitely undesirable.

b. Sewage polluted streams which feed infiltration galleries or shallow well fields may pollute the underground supply if the distance between the stream and the well is short.

3. . Industrial Waste

a. Industrial waste pollution usually occurs by the discharge of waste into the ground through wells.

b. The practice is widely distributed and is increasing in amount and kinds of wastes.

c. Wastes discharged into the ground include: Natural and artificial brines, phenolic compounds, cleaning fluids, salts of heavy metals, metal plating wastes, picric acid, petroleum products, pickling liquors, cannery wastes, milk whey, and spent cooling waters.

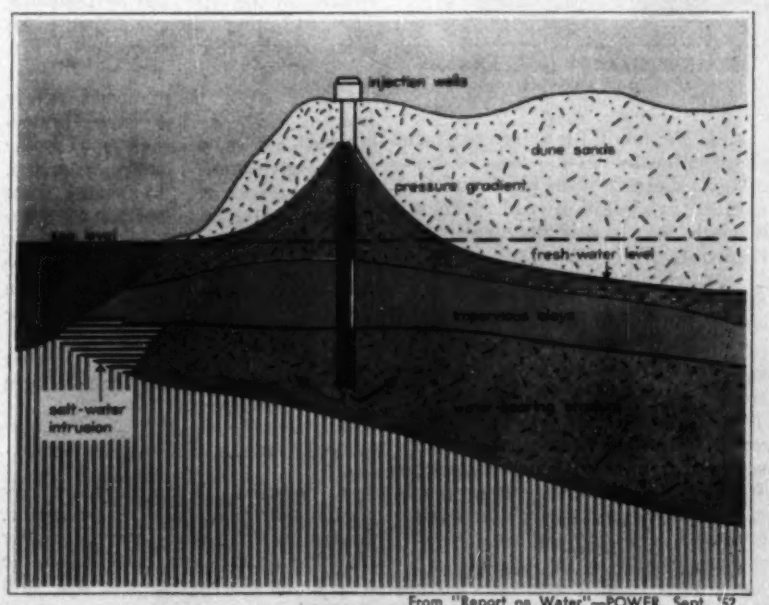
d. Wastes discharged into ground waters move with the water with very little dilution.

e. To avoid pollution of ground water supplies, the practice of discharging wastes into the ground requires careful supervision with particular regard to type of waste, quantity, temperature, geologic conditions, and nearness of ground water supplies in use.

4. . Garbage and Ashes

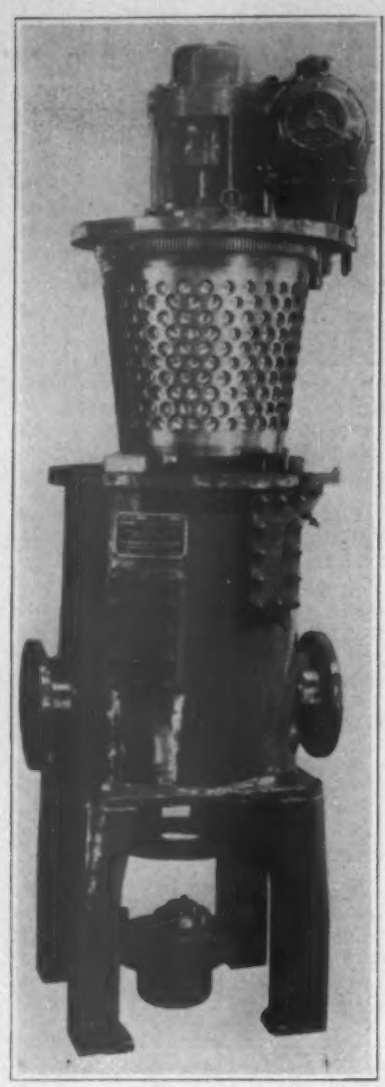
a. Garbage and ashes, when disposed of by sanitary landfill, will cause pollution if the landfill is located in continuous or intermittent contact with the aquifer.

b. Ground water so polluted may contain anaerobic bacteria, hydrogen sulfide, soluble iron compounds, high nitrogen content and increased concentrations of the salts of sodium, magnesium and calcium.



From "Report on Water"—POWER, Sept. '52

DIAGRAM showing method of combatting salt water intrusion by a fresh water barrier



BRASSERT STRAINER for sand removal from well water

c. If the landfill is separated from the aquifer by an appreciable layer of soil, there is little likelihood that natural precipitation will penetrate through the deposit and leach contaminants into the aquifer.

5. . Salt Water Intrusion

a. One of the worst sources of pollution of wells in areas near the seashore is caused by salt water intrusion.

b. Excessive pumping of the fresh water lowers the water table and upsets the pressure balance between the fresh water and the salt water; result, salt water seeps into the fresh water layer.

Ed. Note: Elsewhere in this issue is an article on "Control of Sand in Water Systems" by J. R. Rossum who describes a centrifugal sand separator for measuring the sand content of well waters.

c. Three remedies are available for salt water intrusion:

(1) Reduce the withdrawal rate to equal the natural recharge rate.

(2) Return unpolluted water to the aquifer through special recharge wells with safeguards against pollution.

(3) Create a fresh water barrier by pumping fresh water into the aquifer near the shore. (See accompanying sketch.)

B . . . Operation

1. . Operating Problems

a. *Shortage of Supply* may be caused by:

(1) Overpumping, that is, pumping the water faster than the natural recharge of the aquifer, or faster than the normal rate of flow of the water in the stratum. The remedy: increased recharge as discussed later.

(2) Incrustation of well screens and reduction of amount of water that can enter the well. The remedy for this problem is described later under the section on Maintenance.

b. *Sand* may be pumped continuously from a well. Even in small quantities, it should not be allowed to pass through the pumps into the distribution system.

(1) Dr. Geo. C. Bunker, Cons. Engr. of Quito, Ecuador and Honorary Member of AWWA, has designed a quick method and device for detecting sand in water (see accompanying sketch) and devices are available to remove sand from well water either by strainer or centrifugal force. The Brassert automatic sand strainer of the type used by Houston, Tex., and other cities, is shown in an accompanying illustration.

(2) If sand is pumped rapidly from a well, it may cause underground cavities, which may ruin the well or undermine surface structures. The appearance of sand in water from a well should be a warning to decrease pumping rates or abandon the well if the sand pumping cannot be stopped. In such cases the use of a continuous sampler and sand separator is all but essential.

c. Salt water intrusion or other problems of contamination have been discussed above.

2. . Disinfection

a. Pollution of aquifers by any means may take years to overcome. Minor pollution may be overcome by chlorinating the water as it leaves the well or by chlorinating the well with surging.

b. Water from shallow wells should be chlorinated regularly as a precaution, even though there is little evidence of pollution, because of the ease with which pollution may occur. Chlorine doses required are usually quite low.

c. If regular bacterial analyses are made and prove the water to be uncontaminated, chlorination for precautionary reasons is not necessary.

3. . Operation Procedures

a. *Records* necessary to the proper operation of wells are:

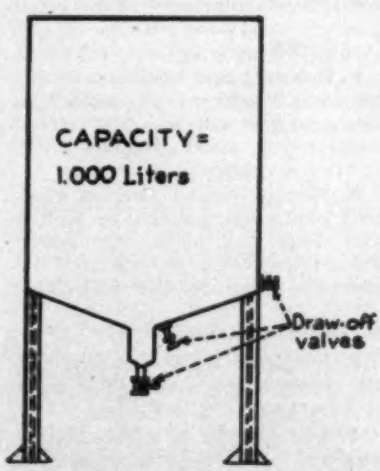
Total volume pumped daily
Hours of operation
Rate of pumping
Identifying number of well in use
Static level measurement (weekly)
Draw down measurements (weekly)
Recovery measurements (twice yearly)
Chloride or other mineral constituents (monthly)
Notes on sand pumping

b. *Static level* measurements, or the level of water in the well when not being pumped may be determined by:

(1) Chalked tape lowered into the water and withdrawn to read the water level. (This method is not feasible if the water is more than 100 ft. below the ground surface.)

(2) Air line, installed during construction, running below the drawdown level. Air pressure necessary to force the water out of the vertical air tube is a measure of the depth of water. (This is the so-called bubble tube; pressure can be supplied from a bicycle pump; an air gage calibrated in feet can be used to indicate depth. See accompanying sketch.)

(3) Electrical conductivity can be used if a slight charge is placed on the casing and an insulated wire lead is lowered into the well until the circuit is completed by the lead touching the water; a buzzer in the system can be used as an audible indicator, and the depth read off the measured wire.



TANK for determining sand in well water

c. *Drawdown measurements,* or the difference between the static level and the pumping level, are most easily obtained by the air pressure method, described above. Drawdown measurements are made after a well has been pumping for two or more hours, or after that period which, as shown by tests, produces the greatest drawdown in a single day of continuous pumping.

d. *Recovery level* measurements are made at least twice a year. After the maximum drawdown has been reached, the pump is shut down and the rise in water level in the well is determined every five minutes until the water elevation is practically back to static level. These data are then plotted against time and compared with similar curves taken twice yearly.

e. *Calculated data,* in addition to information on operation, motor hours, output, etc., may be gained from these records.

(1) Data on the static level and drawdown are indicative of whether or not the aquifer is being overpumped. An even better indication is given by any change in the specific capacity in gpm per foot of drawdown.

(2) Comparison of recovery level curves will indicate if passage of water into the well is meeting with increased friction from plugging of the screens.

f. *Procedures* for obtaining the best results in pumping wells should include:

(1) Stagger well operation, if there are several wells in the field in order to reduce interference.

(2) Rest a well for a 24-hour period at least once a week, if possible.

(3) Pump at a rate equal to one-half of the specific capacity.

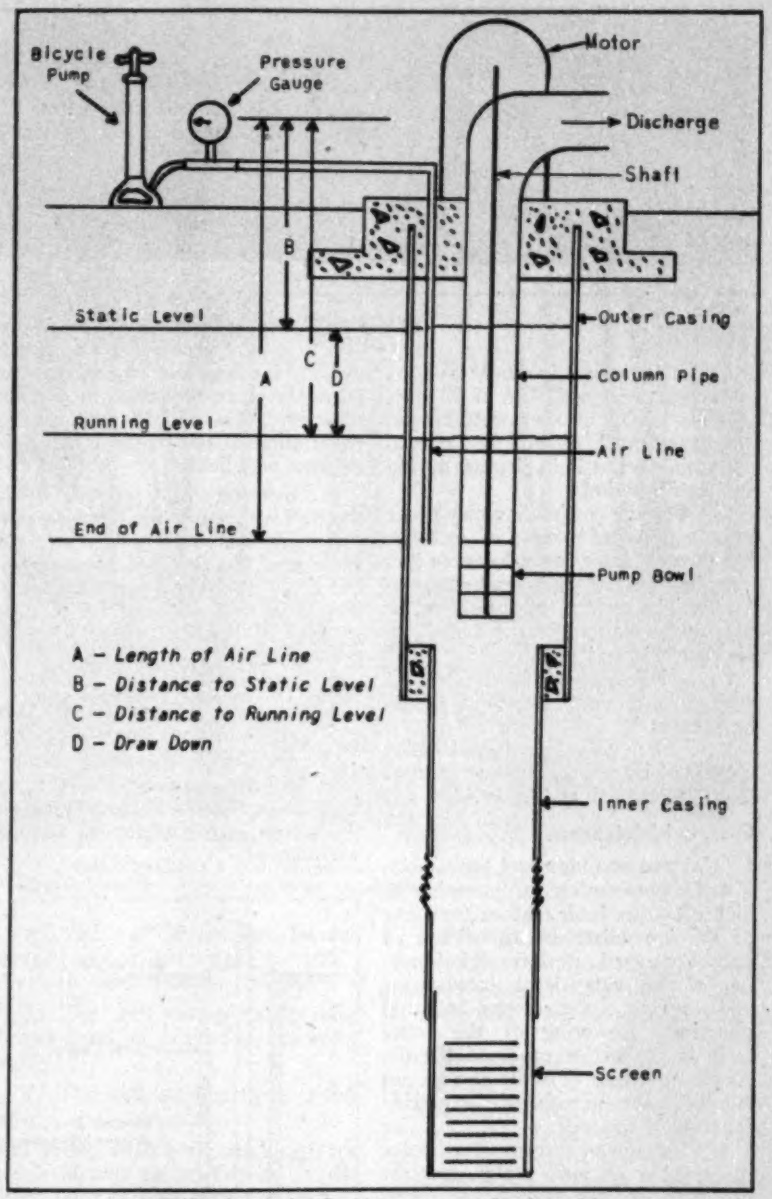
(4) Adopt maintenance procedures when necessary.

g. *Aeration* of well water may be used to remove carbon dioxide, or to oxidize iron so that it can be easily removed.

(1) Tray, spray, step, or coke aerators may be used. Air lift pumping provides its own aeration.

(2) From 10 to 75 per cent of CO_2 may be removed by aeration and H_2S will usually be removed entirely by aeration. Oxidation of iron depends on reducing the CO_2 content to a low level.

h. *Pumping equipment* for wells includes deep well turbine pumps, plunger pumps, or air lift pumps. Pumping will be discussed in a later lecture.



SKETCH of typical well with arrangement for determining water level by air pressure

4. . RECHARGE

a. When aquifers are depleted by over-pumping, the ground water level continues to drop. Water is being used faster than it is supplied by natural recharge.

b. *Artificial recharge* has been successfully used to overcome dropping water levels. Three methods are used:

(1) Spreading water on the surface of the ground in the area where natural recharge occurs, either by the ditch and furrow method or by the alternate basin method.

(2) Return wells into the aquifer. Uncontaminated waters, which have been pumped from the aquifer for cooling purposes are pumped back into the ground. Care must be used to insure that the water is uncontaminated and chlorine should be added to the water as it is returned to the ground to prevent the growth of algae and bacteria.

(3) Recharge wells which tap both a water table aquifer and another aquifer below and allow the water from the upper layer to flow into the lower level from which water is pumped at other wells. Infiltration galleries along rivers or the sandy beds of rivers may be used

c. *Sewage reclamation* (the use of treated sewage effluents for spreading) has received study, particularly in southern California.

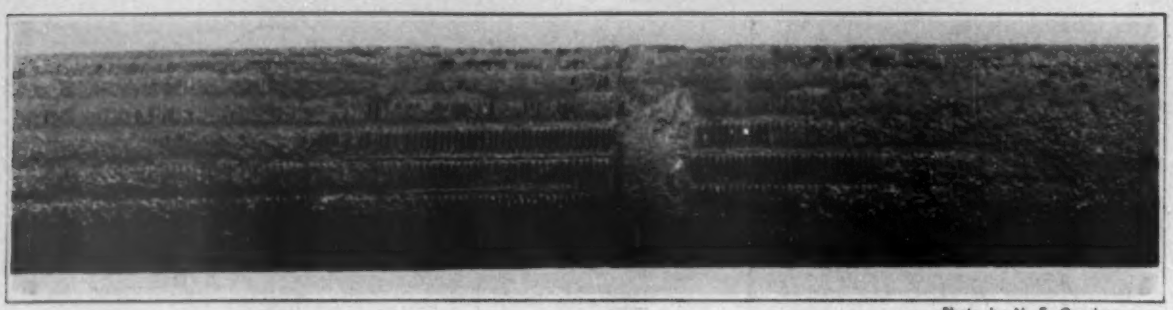


Photo by N. E. Gunderson

ENCRUSTED 18-in. well screen after eight years service

(1) Alternating basin percolation of effluents with a B.O.D. of 30 ppm, at rates of 0.5 cfs per wetted acre, in coarse gravel, showed no bacterial contamination at 7 ft. depths, during one month periods.

(2) Sewage reclamation may prove to be a practical method of recharge but several factors must be taken into consideration before it is adopted:

. . . The treated wastes should be low in organic matter, suspended solids, bacteria and nitrates.

. . . No harmful industrial wastes, such as hexavalent chromium, should be present in the sewage.

. . . The possibility of establishing a cycle of increasing concentration of dissolved salts should be avoided.

C . . . Maintenance

1. . Causes of Output Loss

a. Over-pumping, or pumping at high rates, are basic reasons for many of the immediate causes of loss of output of a well. Both result in lowering of the water level, incrustation and clogging of the screens, and sand pumping. Lowering of the water table is the major cause of the decrease in output of wells and always results in the decrease of the specific capacity of the well.

b. Clogging of screens may be due to bridging of sand grains over the openings, to incrustation; or, occasionally, to the growth of bacteria and slimes.

c. Collapse of a well screen or casing is probably caused by over-pumping.

d. Leaky casings may allow loss of water to "thieving" strata. It may also allow entrance of undesirable water from other strata.

e. Leaky drop pipes (the suction pipe of the pump bowl) will permit air to enter the pump and decrease output.

f. Worn pump impellers or pump bowls will cause a decrease in well output.

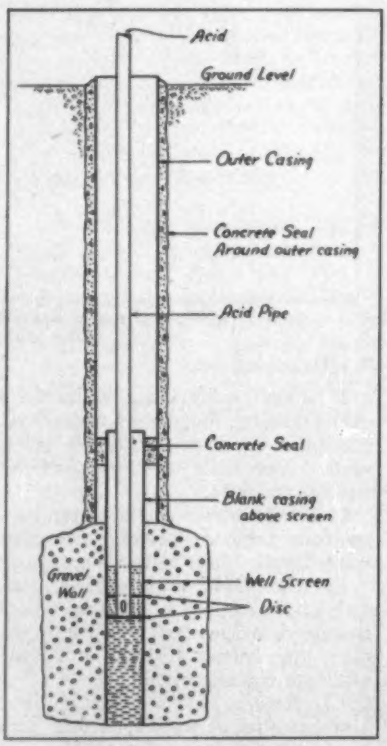
2. . Remedies for Output Loss

a. Reducing the pumping rate is the simplest answer to output loss caused by over-pumping, decrease in water level or decrease in specific capacity. This remedy may involve the drilling of new wells or developing new well fields.

b. Lowering of the pump bowls in the well will return the pumping output to normal in a well where the static level has dropped permanently, but this remedy is not permanent as the static level will continue to drop if the well is being pumped beyond the natural rate of recharge of the aquifer which feeds it.

c. Clogged screens have been remedied by surging, acidizing, chlorination, or Calgon treatment.

. . . If it is sandstone, outside the well screen, that has become plugged, the screen may be removed and the well blasted.



METHOD of applying acid to individual screen sections

3. . Surging

a. Surging is accomplished through a different method than used for surging a new well undergoing development.

b. Disconnect the discharge of the pump and alternately start and stop the pump. This raises the water in the casing and allows it to fall again. If the water level in the well stands at a high elevation, a surge pipe may be attached to the discharge of the pump.

4. . Acidizing

a. Incrustation of screens is caused principally by the deposition of calcium carbonate; deposition of iron compounds is also a factor at times, and calcium sulfate may be deposited under some conditions. See example of incrustation in accompanying illustration.

b. Acidizing with muriatic acid (commercial hydrochloric acid of 27 per cent concentration) is accomplished by adding the acid through a special hose at the level of the screen. This prevents dilution of the acid and gives a concentration of about 15 per cent at the screen. The method is shown in an accompanying sketch.

(1) Inhibitors are added to the acid to prevent it from attacking the metal of the casing, while not affecting the reactivity of the acid with the calcium carbonate incrustation.

. . . These inhibitors are proprietary compounds and may contain arsenic or amine compounds.

(2) Stabilizers, such as acetic acid or citric acid are added to the muriatic acid to prevent redeposition of iron compounds as the acid becomes spent.

(3) Ammonium salts are used if the incrustation is due to calcium sulfate.

(4) Usually the acid is left in the well for at least five hours. (For quicker action, the acid may be heated, particularly if there is a flow of water past the well screen.) After the acid treatment, the well is pumped and flushed to waste until the pH of the water returns to normal.

5. . CHLORINATION

a. Chlorine added to a clogged well may function in two ways: To form weak hypochlorous acid which will attack the calcium carbonate and to attack and destroy bacterial slime growths.

b. Solutions of chlorine containing 50 to 100 ppm of chlorine are prepared and introduced into the well in the same manner as acids are introduced. The well is allowed to stand 24 hours, after which it is pumped to waste until the chlorine content is below 0.1 ppm. Surging during the chlorine treatment is helpful.

6. . CALGON TREATMENT

a. The glassy polyphosphates, the best known being "Calgon," acts as a dispersing agent on such screen plugging materials as amorphous silica, hydrated ferric oxide, iron carbonate, and calcium carbonate.

b. The dose consists of 15 to 30 lb. of Calgon and 1 to 2 lb. of hypochlorite for each 100 gal. of water in the well under static conditions.

c. Allow to remain 24 to 48 hours and surge every two hours or so. If surging is not possible, allow the well to stand for a week; longer treatment may cause well capacity to decrease.

. . . After treatment, pump the well for some hours and test output. Repeat the treatment until the output no longer improves.

7. . COST CONSIDERATIONS

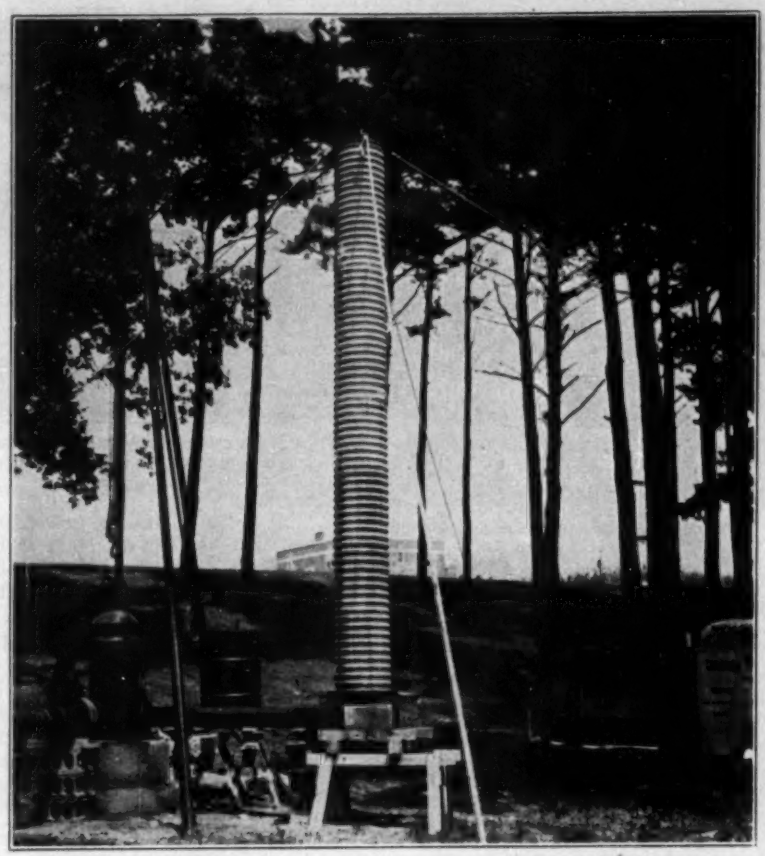
a. When well output drops the cost of operation increases, since more power is required to produce the desired quantity of water.

b. Increased operating costs must be balanced against the cost of maintenance and the cost of abandonment and drilling new wells.

8. . ABANDONMENT

a. Wells may be abandoned for several reasons:

(1) The field has been overpumped and the water level is too low for economical pumping.



CALGONIZING a well for removal of screen and gravel encrustations
Surging wells with high water levels necessitates use of the temporary surge-stack

(2) The well screen has become plugged and it is cheaper to drill a new well than to restore an old one.

(3) The well casing has become corroded and soil is entering the water supply.

(4) The well is pumping too much sand.

b. When wells are abandoned, the casing should be sealed, or if the upper part of the casing is pulled, the hole should be filled with concrete to prevent the entrance of pollution. Sealing or filling a well is also a safety measure for persons who might walk in the vicinity of an abandoned and overgrown well hole.

E. REFERENCE MATERIAL

Material for this lecture was obtained from current water works literature and from these engineering texts:

Babbitt & Doland—"Water Supply Engineering" (McGraw-Hill)

Bennison—"Ground Water, Its Development, Uses and Conservation" (E. W. Johnson)

Hardenbergh—"Water Supply and Purification" (International Textbook Co.)

Steel—"Water Supply and Sewerage" (McGraw-Hill)

NEXT LECTURE

DESIGN CRITERIA

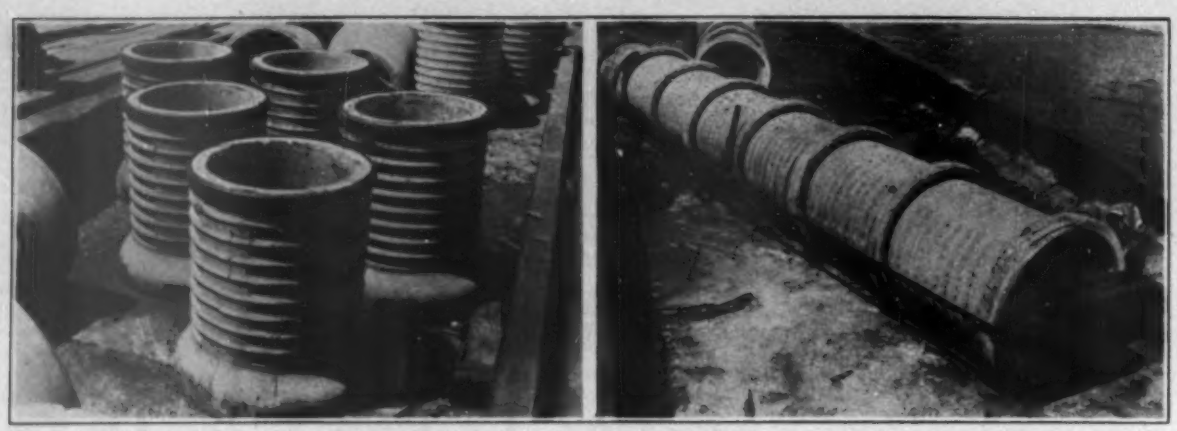
Water from Cloud-Seeding May Be Economical

According to press reports, cloud-seeding is a cheap way to get more water, Dr. Irving P. Krick, president of the Water Resources Development Corp., told the Denver, Colo., Chamber of Commerce.

Comparing precipitation records at Denver before and after cloud-seeding, Krick said there was an increase of 288 per cent at some points. If on an overall average the rise was doubling, he said, Denver's outlay of $10,000 a year yields 330,000 acre feet of water beyond what nature would ordinarily provide.

"This works out at 33 cents an acre foot," he said. "As near as we can tell the average cost from other sources is $10 an acre foot—it ranges $2 to $20—so if we can produce more at 33 cents an acre foot it's a good investment."

> A lot of folks never recognize an opportunity when they meet up with it. One reason may be that it goes around in overalls, and looking a lot like hard work.



SECTIONS of 24" perforated concrete intake pipe, with rubber joint gaskets in place; and, string of assembled sections ready for lowering into river bottom trench.

New Type River Intake

Proves successful at Bellaire on the Ohio.

by A. R. TODD,* *P.E., Wheeling, W.Va.*

A NEW type of river intake, patterned on the scheme of rapid air-field drainage, was designed by the author in 1951 for Bellaire, Ohio. It consisted of 400 feet of 24" reinforced perforated concrete pipe laid on a shale bottom 22 feet below the river bed and extending 100 feet off shore. The depth of the water at that point was 12 feet.

The perforated pipe is connected to a cell or caisson on the river bank by means of 24" unperforated reinforced concrete pipe. The purpose of this stretch of solid-wall pipe was to avoid entry of any hillside ground water, because of its hardness of 750 ppm.

The bottom of the cell (caisson) is slightly below the intake so as to have the intake pipe laid on a falling grade toward the cell. This structure is 7 feet in diameter with 2 foot thick walls and is 41 feet deep. Three Byron & Jackson subermersible pumps were installed with the controls located in the Water Works Building some 600 feet away.

Since the cell during flood stage may be under 35 feet or more of water, the cell was made watertight and non-floating, with a 2 inch vent pipe extending up a telephone pole 45 feet into the air. Sufficient reinforced concrete was used in the thick wall cell to prevent floating under any circumstance. The cell was installed during the summer of 1952, but the intake was not installed until July of 1953 because of a delay in obtaining the 24 inch intake valve.

How Intake Was Laid

The M & O Dredging Company, who had the contract for the river work, laid the pipe as follows: the first 11 feet of river bottom, which consisted of muck, sand and gravel, was cast on the river side by the dredge boat. The next 11 feet, consisting of nice clean gravel, was cast on the shore side and a 22 ft. deep trench 9 feet wide at the bottom and 45 feet wide at the top was secured. The bottom was fairly level and very little cave was experienced. The perforated 24" reinforced concrete pipe with rubber joints was then

*The author is Supt. of Water Treatment at Wheeling, W. Va.

CONTRACTOR'S rig used in trenching, laying pipe and back-filling.

laid under the direction of a diver. Three feet of 2" gravel was placed over the pipe, followed by 11 feet of the ¼" clean gravel that was cast on the shore side. Then 2 feet of clay was placed. A drag, consisting of two pieces 12" x 24" steel beams bolted together, was dragged several times over the top of the trench, after which the top part of the trench was filled with the river bottom that had been cast on the river side. That the river water was sealed off completely was evidenced by the fact that the water cleared up within four hours after the pumps were started. In addition, the analytical results presented herewith reveal the marked dissimilarity of the intake water and the river water.

The cost of installing the intake piping 22 ft. below river bottom was approximately $100 per foot. The caisson, with three submersible pumps, cost $35,000.

Character of Water Obtained

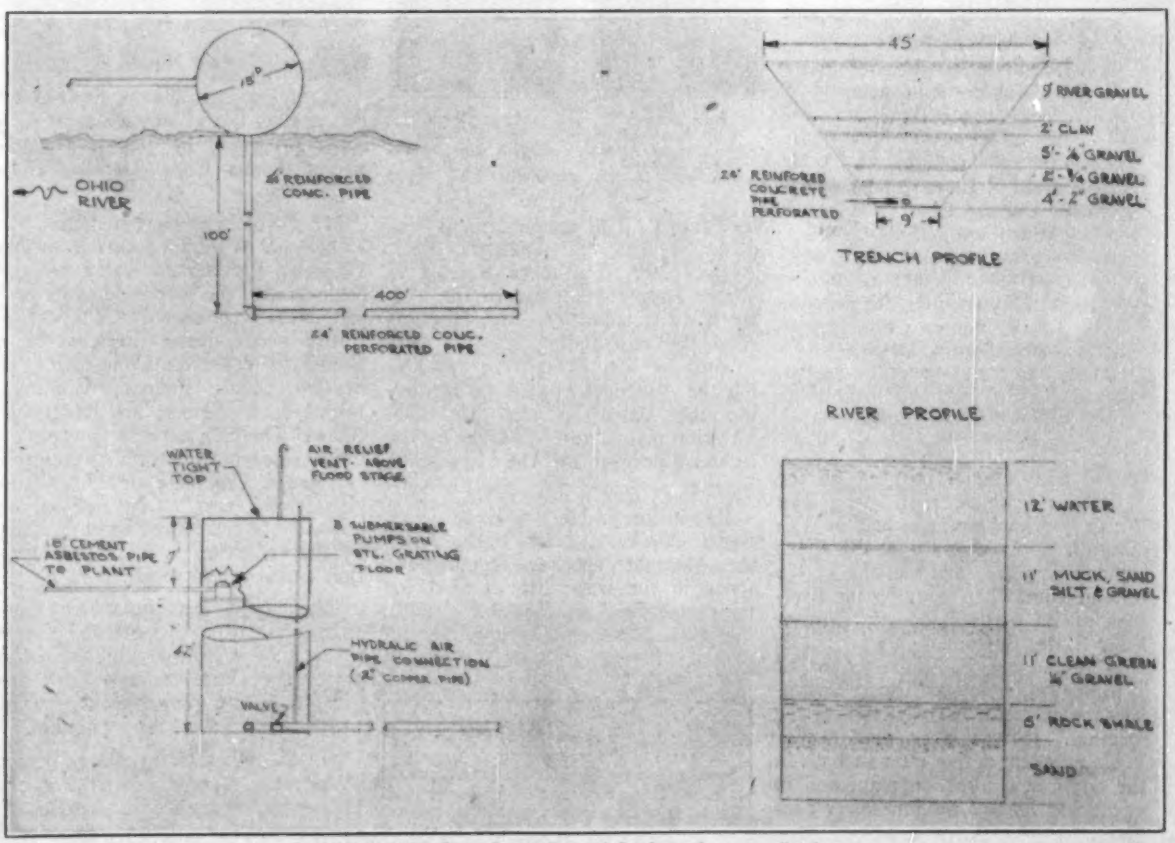
A comparison of the analyses of the river water and the water obtained below the river bed shows no relationship.

	River Water (Sept. 21, 1953)	Below River Bed Water (Sept. 21, 1953)
Temp.	73	68
pH	6.3	7.2
Total Alk.	15 ppm	160 ppm
Total Hdn.	160 "	360 "
Chlorides	22 "	35 "
Fluorides	.1 "	.4 "
Iron	2.5 "	.1 "
Mn.	.4 "	0.2 "
Turbidity	23 "	0 "

SUBMERSIBLE pump-well and caisson.

Results Far Exceed Expectations

On September 18th, 1953, the pumps were tried out and were left on for four hours. The water had cleared up of turbidity by that time. With all three pumps on (total capacity of 6 mgd) it was impossible to lower the water in the cell more than a few inches. By partly closing the intake valve and with all three pumps on, the water was lowered 15 feet, but when the valve was again opened wide the water immediately rose to its previous level.



DETAILS of trench, intake piping, and flood-proof pump-well caisson.

Chesapeake AWWA Section Holds 5th Annual Meeting

Retiring Chmn.
Geo. L. Hall
Chief San. Engr.
State Health Dept.
Baltimore, Md.

Incoming Chmn.
Harry B. Shaw
Chief Engr.
Wash. Sub. San. Com.
Hyattsville, Md.

New Officers

Past Chairman

George L. Hall, Chief Engr.
State Health Dept.
Baltimore, Md.

Chairman

Harry B. Shaw, Chief Engr.
Washington Sub. San. Com.
Hyattsville, Md.

Secretary-Treasurer

Carl J. Lauter, Sr. Chem. Engr.
Washington Aqueduct
Washington, D.C.

National Director

David Auld, Supt. & Chief Engr.
Water Dept.
Washington, D.C.

New Trustees

R. W. Haywood, Jr., Engr.
E. I. Dupont Co.
Wilmington, Del.

B. L. Werner, Deputy Water Engr.
Bureau of Water Supply
Baltimore, Md.

THE fifth annual meeting of the Chesapeake Section, American Water Works Assn., was held in Wilmington, Del., October 28-30. This actually was the 33rd meeting of the organization, when counting the meetings of its predecessor—the former Four States Section.

Hon. August F. Walz, mayor of Wilmington, welcomed the 192 members and guests who registered for the meeting. It was clear that Mayor Walz takes an active interest both in the city's new filtration plant and in advancing its $12 million sewer program.

Social events at the meeting included a get-together evening before undertaking the technical program, and the banquet with music and dancing. A cocktail hour was provided through the courtesy of the Water and Sewage Works Manufacturers' Assn. For the ladies, there were tours to the duPont Museum, a luncheon, and a fashion show.

GEORGE L. HALL, Chief, Div. of San. Eng., Maryland State Health Dept., was chairman of the meeting.

Fuller Award

EDWIN A. SCHMITT, Head Engr. & Chief, Water Supply Div. of the Washington Aqueduct, was selected as the recipient of the Section's *Fuller Award*. The announcement was made by EDW. S. HOPKINS, Prin. Assoc. Engr., Baltimore Bureau of Water Supply, chairman of the Fuller Award committee. Mr. Hopkins cited the outstanding services performed by Mr. Schmitt in developing the Aqueduct system, in improving the Dalecarlia and McMillen filtration plants, and in advancing the technical programs of the Chesapeake Section.

Fuller Award
Edwin A. Schmitt
Head Engr. and Chief
Wash. Aqueduct
Washington, D. C.

Local Chmn.
Edw. B. Showell
Water & Waste Superv.
E. I. du Pont Co.
Wilmington, Del.

RAYMOND J. FAUST, Exec. Asst. Secy., AWWA, New York, N.Y., the banquet speaker, commended those in the water works field for their contributions to public health. He pointed to the growing per capita demand for water, now more than 138 gallons (over one-half a ton), as evidence of a vital and expanding business. He called attention, however, to "weak spots": emphasizing a "lack of vision" in more than a third of the nation's water supplies to provide for future water needs; and, what may constitute our greatest need, failure to raise the technical and financial level of supervisory personnel.

We regret that space limitations have made it necessary to delay the publication of this meeting report and to condense our review of several of the technical papers presented.
—The Editors

Secy.-Treas.
Carl J. Lauter
Sr. Chem. Engr.
Corps. of Engrs.
Washington, D. C.

Natl. Director
David Auld
San. Eng. Dir.
D. C. Engr. Dept.
Washington, D. C.

Technical Program

Baltimore's Future Needs

"THE FUTURE WATER SUPPLY OF BALTIMORE CITY" was the topic of a paper presented by JOS. S. STROHMEYER, Water Engr., Dept. of Public Works.

Mr. Strohmeyer reported that, for 75 per cent of the time *during the last 27 years* Baltimore's water demand has exceeded the safe yield of its supply. Nearly completed is a report on future needs, being prepared by a Board of consultants consisting of Messrs. Abel Wolman, Whitman, Requardt & Assoc.; and Harry B. Shaw. The city expects to complete a new reservoir and filter plant within two years. Complete metering of the city would cost $1.16 million, an amount not considered to be justified by the reduction in water consumption which would result.

The city's consultants have carefully evaluated all potential future sources of water supply for Baltimore; they have endeavored to predict the future growth of the metropolitan area and of its population.

G. C. REQUARDT, Cons. Engr., Whitman, Requardt & Assoc., Baltimore, summarized the Board's recommendations. In accordance with these, the city will go to the Susque-

"GET-TOGETHER" evening gets the meeting off to a good start

hanna River for a supply which will require pumping from the source. An additional supply of 220 mgd can thus be provided; filtration will not be immediately required.

Dr. Abel Wolman, Prof. of San. Eng., Johns Hopkins Univ., Baltimore, reviewed the implications of the Board's report. The city has, in a 100-year period, received 26 reports on its water system; three of these have been compiled since 1930. Each report has underestimated future water needs, and all cost estimates have been too low: Baltimore has spent (mainly in the last ten years) $33 to $35 million more than was indicated in earlier cost data. He pointed out that sociologists have been closer than engineers have been in estimating the expansion of metropolitan areas. The trend now is toward providing emergency (occasionally needed) water supplies, rather than making large investments in impounded supplies.

Harry B. Shaw, Chief Engr., Washington Suburban Sanitary District, Hyattsville, Md., called attention to the interdependence of municipal and metropolitan water supply. By the year 2000, it is estimated, the population of suburban areas will have increased at a rate greater than that of the city; Baltimore will have a population of 1.3 million, and the suburbs of 0.9 million.

Raw Water Quality

"Water Supplies, Better or Worse" was the title of a panel discussion. The moderator was Robt. L. Haywood, Jr., Engr. Dept., E. I. duPont Co., Wilmington, Del.

Baltimore's Future Water Supply

Jos. S. Strohmeyer, Water Engr., Water Supply Bur., Baltimore, Md.

G. J. Requardt, Partner, Whitman & Requardt, Baltimore, Md.

Abel Wolman, Prof. of San. Eng., Johns Hopkins Univ., Baltimore, Md.

Panel Chmn.

R. W. Haywood, Eng. Serv. Div., E. I. du Pont Co., Wilmington, Del.

W. McLean Bingley, San. Engr., Maryland State Dept. of Health, Baltimore, Md., described the increased pollution of streams, the awareness and accomplishments of industrial polluters, and the expansion of municipal sewage treatment plants. New legislation and new financing has been required, studies of special industrial wastes are needed, and training courses are needed for plant operators.

D. K. Harmeson, San. Engr., Delaware State Board of Health, Dover, Del., asked: "Water supplies better or worse than what?" The efforts of pollution control authorities, he pointed out, have been materially benefited by increasing public interest in controlling stream pollution.

Edwin R. Cotton, Director, Interstate Comm. on Potomac River Basin, Washington, D.C., reviewed the changing concepts of water quality. The treatment required for wastes is increasingly related to the assimilation capacity of the stream receiving the discharge. Potomac River water is now used five times over, before reaching the end of its flow. Acid mine drainage is increasing, and trace substances may have a cumulative effect about which we now have little information.

Mr. Haywood concluded that water supplies are better *and* worse; progress has been made, but there is much to be accomplished.

Keeping Water Clean

"Why Sanitation on Watersheds" was a topic discussed by Edw. S. Hopkins, Prin. Assoc. Engr., Bureau of Water Supply, Baltimore, who said, essentially, that there should be an economic balance between money spent for water purification and for watershed sanitation.

Mr. Hopkins cited the practices of New York City in controlling reservoir areas where storage and chlorination are the only purification processes.

A cooperative program for the protection of a watershed area has been developed by the Maryland State Health Dept., the Baltimore Bureau of Water Supply, Congoleum-Nairn, Inc., and Schenley Distilling Co. for the treatment of industrial wastes at Cedarhurst, Md. The two industries have invested some $900,000 for facilities including lagoons, biofiltration treatment, and final chlorination.

When recreational activities are permitted on watersheds, it was recommended that they be supervised by the water department rather than other agencies. Rather than providing elaborate inspection and protective procedures, the general trend seems to be toward efficiently operated water treatment practices.

J. M. Jester, Engr. of Maint. and Opera., Washington Suburban San.

TWO PANELS: On Water Supply quality, and on New Material and Equipment

Watershed Sanitation
Edw. S. Hopkins
Prin. Assoc. Engr.
Water Supply Bur.
Baltimore, Md.

John M. Jaster
Engineer
Wash. Sub. San. Com.
Hyattsville, Md.

New Equipment
David A. Wood
Sales Engr.
Alan A. Wood
Washington, D. C.

John C. Smith
Asst. Chief
Corps of Engrs.
Washington, D. C.

Comm., Hyattsville, Md., described problems and practices in watershed sanitation. Farm and roadside erosion create the principal problem of pollution (67 watercourses drain into the reservoir). The Sanitary Commission cooperates with a number of other authorities in a program of erosion control by grading, seeding, and planting multi-flora rose bushes.

New Equipment Panel

"New Water Works Material and Equipment," was the title of a panel discussion. The moderator was Bernard L. Werner, Deputy Water Engr., Bureau of Water Supply, Baltimore.

"Plastic Pipe Applications" was the topic presented by J. C. Smith, Asst. Chief, Water Supply Div., Washington Aqueduct, Washington, D.C.

Mr. Smith stated that the interest of Aqueduct authorities in plastic pipe developed during World War II when shortages in standard materials became significant. He reviewed the chemical and physical properties of a variety of plastics. Tests on sample pipes (and fittings) include determination of immersion, pressure, and chlorine absorption characteristics. Uses of plastic pipe in Washington treatment plants were illustrated by means of lantern slides: fittings for chemical feed devices, chlorinator vent pipes, water sampling lines, and electric conduit.

"Instrumentation and Controls" was the topic reviewed by David A. Wood, Alan Wood, Inc., Washington, D.C.

The utility of central control station panels is receiving increasing recognition, and Mr. Wood described a number of such installations. Human errors may be lessened by modern automatic-operation devices (which provide for manual control). So-called master control units may be designed to operate instantaneously or for gradual shutdown. A graphic pumping layout, using correlation diagrams, is another useful control device.

"Experience with Mechanical Joint Pipe" was reviewed by Roy L. Orndorff, Supt. of Office Planning, Govt. of D.C., Washington, D.C.

The District of Columbia started the use of mechanical joint pipe in 1942, with a one mile long installation of 24-in. pipe. So satisfactory was its experience, that by 1949 this type of pipe was adopted as the standard for all 8-in. lines; this type also is used to a considerable extent in lines of other sizes (4-in. to 24-in.). Cost is not a factor, though it appears to be slightly less for this type of pipe. The ease of obtaining tight joints is of inestimable value, and flexibility of the line is superior to that of bell-and-spigot type pipe. The bolts employed were about the only cause for dissatisfaction; they are now of better quality, and the use of torque limit wrenches has helped reduce breakage.

Justin E. Farrell, Construction Engr., Washington Suburban Sanitary Dist., Hyattsville, described the experience with mechanical joint pipe in his system.

Approximately 150 miles of this type of pipe has been placed in service since early 1950. Mechanical joint pipe is now used almost exclusively. Experience shows: joints are made more rapidly; heating of jointing compound is not required; the joints are tighter; joints can readily be made under wet conditions; and main sterilization is accomplished more readily when this type of pipe is used.

Mr. Farrell emphasized that proper bracing is definitely needed with mechanical joint pipe. It has been shown that the use of soapy water and torque limit wrenches is important to assure proper jointing. Contractors employed by the District prefer to install this type of pipe.

Filter Plant Economy*

"The Occoquan Filter Plant" was described in a paper presented by E. H. Aldrich, Chief Engr., Amer. Water Works Service, Philadelphia, Pa.

Mr. Aldrich listed the advantages of the type of filter design employed at the Occoquan Filter Plant. These included very low head losses, with the elimination of negative heads during operation; little or no disturbance of floc during its passage to the filter; substantially reduced costs of construction and operation over conventional designs.

The American Water Works Service Company considers filters of this type to have passed the experimental stage; it now is designing and constructing similar units for other plants operated by them. It is believed that individual units may be constructed of sufficient size to treat up to 10 mgd.

A chart was displayed showing the comparative construction costs for conventional plants and those of the Occoquan type through a wide range of sizes. Construction costs for the latter averaged about 50 per cent of those for the 25 conventional plants with which this plant was compared. The Occoquan Plant has used both Wheeler and Carborundum filter bottoms with satisfactory results.

Panel on Special Filter Bottoms

"Leopold Bottoms" were discussed by M. L. Stuppy, F. B. Leopold Co., Pittsburgh, Pa.

The development of Leopold Bottoms began in 1926. The original units were constructed of concrete, but experience in some localities showed concrete was not satisfactory because of structural failures. Units now are constructed of glazed tile. Small 5/32-in. perforations in the tile produce multiple jets giving fine, even dispersion throughout the bed. Therefore, the only function of the 6-in. gravel layer is to support the sand. The tendency of water to cut channels is eliminated.

There is no metal in contact with the water; the glazed fire clay units are durable and permanent. A filter bottom constructed of Leopold units presents a large flume area which assures low velocities for wash water. There are 35 holes per square foot of filter bottom. The shallow gravel bed permits construction of lower—and therefore cheaper—filter boxes. There is no requirement for complex concrete work in connection with the filter bottom.

Units of this type are ideal for replacement of other types of bottoms in existing plants, as these units are

*This paper, and the panel discussion which follows, were reported by David Auld, San. Engr. Director, D.C. Engr. Dept., Washington, D.C.

readily adaptable to a variety of conditions. The large flume areas provide low head losses for wash water. Overall cost of filters with Leopold bottoms is considered to be competitive with other types. Leopold bottoms have been installed in about 200 plants having a total capacity of about one and one-quarter billion gallons per day.

"WAGNER BOTTOMS" were discussed by RICHARD MULLER, International Filter Co., Tucson, Ariz.

The Wagner method comprises a primary system (a manifold and laterals) and a secondary system. The secondary system consists of Wagner pre-cast concrete blocks laid in among the manifold and laterals. There is considerable flexibility possible in the pipe-and-block arrangement. One advantage is that conventional pipe, transite, cast iron, etc., may be used for the manifold and laterals.

The pre-cast blocks are made at the job site using local labor; two men may be expected to produce from 80 to 100 blocks per day and, if fully experienced, their output may reach 200 blocks per day. A one mgd filter box, designed for filtering 3 gpm per square foot, would require about 280 blocks. The materials cost will be 10 cents for each block, and labor 50 cents each, giving a total of $167 for the filter.

Through use of the Wagner bottom, the conventional 18-in. to 24-in. gravel layer may be reduced to 14-in. by elimination of the large gravel. Pressure losses through the block system are considered low; blocks cannot clog; they can be easily removed for making repairs to filters; and are suitable for any size filter bed. Installation is simple, no grout is required; and less wash water is required because of efficient distribution within the bed. There have been about 500 installations of Wagner bottoms.

WHEELER BOTTOMS were discussed by J. R. HARTLEY, Builders-Providence, Providence, R.I.

Highways
Richard C. Willson
Superintendent
Water Dept.
Hagerstown, Md.

Filters
Elwood H. Aldrich
V. P., Chief Engr.
Am. W. W. Serv. Co.
Philadelphia, Pa.

Special Filter Bottoms
John R. Hartley
Vice-President
Builders-Prov. Inc.
Providence, R. I.

Frank C. Roe
Sales Devel. Engr.
Carborundum Co.
Perth Amboy, N. J.

The Wheeler bottom was evolved about 1907, and the principles have remained substantially unchanged since that time. These units are elevated above the bottom of the filter boxes, forming a false bottom; the lower area providing unrestricted flow for circulation of wash water. Openings through units are provided with porcelain orifices in the bottom and have the form of inverted pyramids. The top of the pyramidal openings is filled with porcelain spheres.

The system assures a head loss during filtration in the order of 1-in. Losses during washing attributable to the bottom vary from 2 ft. to 3 ft. of head. Units may be pre-cast by the manufacturer and shipped to site, or the entire bottom may be cast in place using metal forms provided by the manufacturer. Only a 10-in. to 12-in. of gravel is required; pre-cast blocks may be installed by unskilled labor; spheres remain in position at all ordinary wash rates; wash water distribution is good; bottoms are extremely durable; no broken porcelain spheres ever have been encountered after use; there are no small openings to clog; costs are low as compared with other non-metallic bottoms.

CARBORUNDUM BOTTOMS were discussed by F. C. ROE, Carborundum Sales, Perth Amboy, N.J.

Mr. Roe emphasized that he represented a materials supplier, not a manufacturer of filter bottoms as such. Carborundum plates permit elimination of gravel entirely. While generally 12-in. x 12-in. units are used, special sizes can be made as required. Early Carborundum plates were found to be too fine in texture and this condition has been completely corrected. No gravel is required; Carborundum plates support sand directly. The filter structure may therefore be correspondingly shallower.

Plates are kept in place by hold-down bolts of stainless steel. The plate supports are of clay tile. It is claimed that head losses both during filtration and back-washing are held to a minimum. The Hardinge filter, using only 12 in. of sand, employs the Carborundum filter bottom. There have been about 300 installations of these versatile Carborundum bottoms.

Papers Not Reviewed

"WATERSHED CONTROL OF BRANDYWINE CREEK," by CLAYTON HOFF, Secretary, Brandywine Valley Assn., Delaware.

"UTILITY CHANGES REQUIRED BY HIGHWAY PROGRAMS," by ROBT. J. MCLEOD, Div. Engr., Washington Sub. San. Dist., Hyattsville, Md., and R. C. WILLSON, Supt., Water Dept., Hagerstown, Md.

"SUBMERSIBLE PUMPS FOR MUNICIPAL APPLICATION," by H. L. FRENSDORF, Gen. Sales Mgr., Lancaster Pump & Machinery Co., Lancaster, Pa.

R. H. Gould Joins Greeley and Hansen

Greeley and Hansen, Engineers, Chicago, Ill., have announced that Richard H. Gould, formerly Director of the Division of Sewage Disposal, Department of Public Works, New York City, has become a member of their staff.

Mr. Gould for the past 25 years has been responsible for the engineering aspects of the general plans for sewage disposal and for the design, construction and operation of all sewage disposal projects of New York City. Notable advances in the practice and methods of sewage treatment have been developed under his direction. In recent years he has also directed the design and construction of extensive works for incineration of the refuse of that city.

Mr. Gould has been consulted on the problems of a number of outside communities. Prior to joining the City he was in private practice with the late James H. Fuertes and has served as a Special Lecturer at the Massachusetts Institute of Technology.

Are You One?

Too many people make the mistake of looking afar for things which are really close by.

Control of Sand in Water Systems*

Methods of measuring sand concentrations, well operation, and main flushing procedures

by JACK R. ROSSUM, Engr. of Sanitation, California Water Service Co., San Jose, Calif.

SAND is frequently a problem to the operator of a water system supplied from wells. The abrasive effects of sand cause severe wear of pumps, chlorinator injectors and valves. By abraiding consumer's fixtures, sand will contribute materially to water waste. Sand, clogging the orifice of a control mechanism, may cause the failure of important equipment. Sand may stop meters and thereby decrease revenue; and, by clogging consumer's fixtures, especially automatic washing machines and sprinkling systems, sand may bring about consumer complaints. Excessive sand production from a well indicates the formation of cavities, and the possible collapse of overlying strata which would damage the well. Studies have shown that the accumulation of sand in pipe may markedly increase friction and head loss.

There is little in the literature regarding the control of sand except for discussions on the design of sand traps using Stokes' Law or its modifications relating settling rate to particle size. The engineer faced with the problem of designing a sand-trap may use these formulae to compute the dimensions of a trap that will remove, for example, 95% of all particles having a diameter of 0.2 mm., but this is of little value unless the sand concentration in the supply can be quantitatively determined and the quantity of sand that can be tolerated in a distribution system established.

Method for Determination of Sand Content—First Control Step

The first step toward the control of sand appeared to be the development of a method for the quantitative determination of the concentration of sand at its source. Applying the term "quantitative determination" to sand implies that the word "sand" has an exact meaning incapable of misinterpretation. Yet, sand grades imperceptably into gravel on one hand and into silt on the other, so that any precise definition of sand must include arbitrary and artificial limits on particle size. For the purpose of this discussion, such a definition is undesirable and unnecessary, since physical conditions impose an upper limit as to the size of rock particle that can be pumped from a well, and the lower limit is roughly established as those silicous particles that can be removed in a conventional sand-trap.

Fig. 1—Sand filter and meter.

The collection of a representative water sample for sand determination has been given careful consideration. A sample collected from a horizontal pipe carrying water at low velocity is unsatisfactory. It has been demonstrated that representative samples can be obtained from vertical pipes, and fairly satisfactory samples may be taken from horizontal pipes if the flow is highly turbulent. Samples taken immediately downstream from ells, tees and other fittings that create turbulence are generally satisfactory where there is a water velocity of 5 feet per second or greater. The water velocity through the sampling tap at the point of diversion from the main stream should not be lower than the velocity in the main stream.

The concentration of sand in water from any given well varies with operating conditions. This complicates the problem of sampling, for if a sample is to be representative of the average sand concentration, it must be taken over a considerable period of time during which the flow through the sampling device must be reasonably constant, and the design of the sand collector must be such that it will function properly with infrequent attention. On the other hand, it is often desirable to take samples over a very short period of time. For this, the sand sampling device must be capable of handling sufficient volume of water in a few minutes to permit the separation of a sand sample of adequate size.

A review of the water works literature uncovered very little previous work on the quantitative measurement of sand. Hamel[1] illustrates a sand content indicator. In a communication to the author, Hamel has described the use of this device. In effect, a five-gallon bottle serves as a settling basin to collect the sand from a known volume of water. The quantity of sand collected is measured and its concentration computed. George C. Bunker in *Water & Sewerage*[2] describes a method whereby a two-liter water sample is collected, swirled, and after settling, the resulting sand disc is compared with standards of known concentrations.

Development of a Filter and Centrifugal Sand Separator

Trials of numerous devices for collecting sand samples, including those of Hamel and Bunker, led to the conclusion that for samples collected over a short time interval, filtration was the most practical and convenient method. For continuous sampling, a centrifugal sand separator was found to be superior to other types considered.

The filter device is illustrated in Fig. 1. Essentially, it consists of a cloth filter followed by a meter. The filter frame is fabricated from a meter case so arranged that the cloth filter disc is supported on a perforated supporting disc having a diameter of about 5 inches. The cloth is firmly held between gaskets, and wing nuts facilitate its insertion and removal. Water enters through a hose connection on top, flows through the filter, through the meter and thence to waste. The cloth used is mercerized batiste, selected because it can be purchased in almost any dry goods store, has about the right porosity, and is reasonably uniform. Where the water to be sampled is under a pressure of about 50 pounds per square inch, 50

*This paper, presented before the California section of the Am. Water Works Assn., is here printed by permission of the Association.

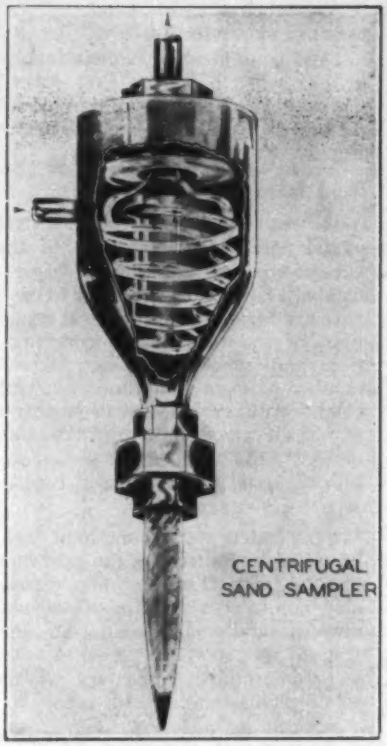


Fig. 2—Phantom drawing of centrifugal sand separator

cubic feet may be sampled in less than 20 minutes. It is seldom necessary to collect samples larger than this.

The cloth filter retaining the sand and silt is sent to the laboratory, along with a report giving the size and location of the sampling tap, pertinent data on the well operation, and the volume of water sampled. Upon arrival in the laboratory, the sand is dried, its volume measured and its concentration computed. It may then be subjected to particle size or settling rate analysis if desired.

The filter type sand sample collector is limited to applications where it can be attended continuously. As soon as an appreciable quantity of sand is collected, the head loss through the filter increases and the quantity of water flowing through the machine decreases to a point where the velocity at the point of sampling is too small to assure a representative sample. To avoid such difficulty a centrifugal type sand sample collector was developed.

Christensen[6] discusses the principles of design of centrifugal type sand separators. Fig. 2 is a phantom sketch of a sand tester that embodies these principles and is adapted to the purpose in hand. Fig. 3 shows a centrifugal separator in operation.

Water enters the body of the device tangentially immediately below a ring-baffle. The small radius and high velocity create a large centrifugal acceleration which throws the sand to the wall of the device. The sand slides down the side and is collected in the centrifuge tube below, while sand free water flows out through the hole in the center of the ring-baffle. The flow is maintained at a constant value, independent of the inlet pressure, by means of a flow control valve that is rated at 0.5 gallon per minute. At suitable intervals, the volume of sand collected is recorded, along with the number of hours of operation. From this data, the average sand concentration may be computed, since the flow rate through the tester is constant and known.

The ingenious and simple patented flow control valve contains a rubber orifice that contracts with increasing inlet pressure so as to maintain a constant flow. According to the manufacturer, it is designed for a pressure variation from 15 to 150 psi. We have tested the device over a pressure range of from 20 to 120 psi. and have found less than 10 per cent variation in the flow, although the actual flow may be as much as 20 per cent above or below the rated value. We are unable to present any data as to the useful life of this valve which is manufactured by the Dole Valve Co., Chicago 12, Illinois.

Application of the Centrifugal Tester

The use of a centrifugal sand tester on a well permits sand production to be recorded daily. Any significant increase is noted immediately, and corrective action can be taken before appreciable quantities of sand have entered the distribution system. The low cost of these testers makes it feasible to provide one of these "watch-dog" units for each well that is suspected of producing excessive sand.

While sampling procedures were still in the experimental stage, it became obvious that screen analyses were unsatisfactory for determining settling rates since the sand usually contained mica. Methods for determining the settling rate in water directly were tried, but they were all so cumbersome and inconvenient that they were abandoned in favor of an air method. The equipment built for the purpose is illustrated in Figs. 4 and 5.

Pneumatic Settling Rate Tester

Compressed air enters at a suitable rate controlled by a needle valve. This rate is easily reproduced by means of a pressure gauge and an orifice.

Fig. 3—Centrifugal sand separator in service

Straightening vanes reduce the turbulence of the air stream. Sand from the hopper impinges on the baffle and falls into the air stream as a thin ribbon. The sand-laden air is prevented from assuming lateral flow by parallel glass plates. The most rapidly settling particles fall into the pocket of section 1, while the finer and slower settling particles are carried progressively on to sections 2, 3 and 4. The air flow is initially established and the machine calibrated by trial. A representative sand sample is run through the machine at several different air rates, and individual particles collected from each section. These particles are dropped, one at a time through the column of water in a liter graduate, and their sedimentation rates determined with a stopwatch. It was found convenient to adjust the air blast so that the sand falling in section 1 had a settling rate of greater than 7 feet per minute; section 2, 3 — 7 feet per minute; section 3, 2.5 — 3.0 feet per minute; and section 4, less than 2.5 feet per minute.

In the use of the machine, the sand sample is first dried and its volume determined in a centrifuge tube. The airblast is turned on and adjusted to its proper volume. The sand sample is then poured into the hopper. After the sand has been graded, the

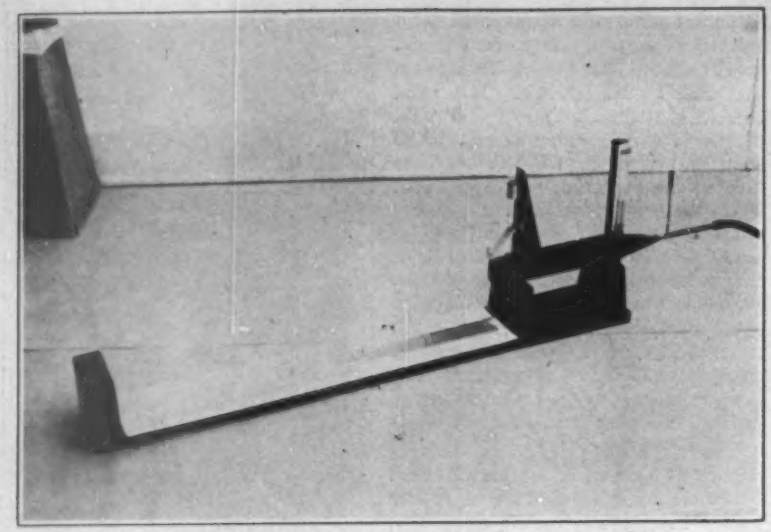


Fig. 4—Pneumatic sand grader for determining settling rates in sand testing

volume falling on each section is determined. The total sand concentration and the percentage of sand in each group is reported. If the sample is less than 1 cc., satisfactory results can be obtained by weighing the sand on an analytical balance.

During the early stages of this investigation, sand concentrations were determined and reported gravimetrically, but is now felt that the much more rapid and convenient volumetric method had an accuracy that is commensurate with the accuracy of sampling. Results are reported in cubic feet of sand per million gallons of water— (cf./mg.).

What the Testers Have Revealed

The use of sand testers has yielded some interesting and significant information on the behavior of wells with respect to sand production. So far, experience with sand testers has been limited to wells drilled in recent alluvial formations where the aquifers consist of relatively thin layers of sand or gravel. Sand testers have been installed on gravel packed wells, perforated casing wells and open bottom wells.

When sand production for an individual well is measured at various rates of flow, the concentration of sand varies exponentially with water production. In making these tests, sufficient time must elapse between each measurement to permit the sand concentration to reach a steady value. When these results are plotted, the points fall on a smooth curve represented by the equation:

$$\text{Sand Concentration} = \frac{(\text{G.P.M.})^n}{K}$$

The value of "n" has been found to vary from about 5 to over 20. It is commonly about 15. Thus, a small change in water production from a well makes a large change in sand production.

The data for three wells is shown in Fig. 6. Similar results have been obtained from tests on six additional wells. Three of these fit the exponential equation very well, two of them exhibit a few erratic points which are attributed to inaccurate data. In one well, surprisingly enough, sand production actually ceased when the pumping rate was increased above a certain flow. In this exceptional instance, it is believed that all the sand was coming from the uppermost set of perforations, and that when the pumping rate increased to a point where the water level dropped below this set of perforations, sand production stopped.

Sand concentration is considerably greater when a well is first started than it is after a period of continuous operation. This effect is illustrated in Fig. 7.

Sand Traps and Separators

It was hoped that sand testers would permit the evaluation of the various types of sand traps. Unfortunately, it has not been possible to compare sand traps under identical conditions of water flow, sand concentration, and effective particle size. A number of tests made under varying conditions have failed to demonstrate any significant difference in efficiency between the horizontal sedimentation type and the centrifugal type of separators or sand traps.

Sand testers were found to be highly useful in controlling the operation of sand traps. They permit a reasonably accurate calculation of the volume of sand accumulated in a sand trap so that it may be flushed when a predetermined percentage of the total volume is filled with sand.

Prior to the use of the sand testers, many sand traps were flushed much more frequently than necessary. Sometimes, this was detrimental because opening the blow-off valve on the trap resulted in a lowered discharge head on the pump. This caused a material increase in water production, which, as discussed above, caused a very large increase in the rate of sand production. Instances have been encountered where wells produced more sand in the few minutes during

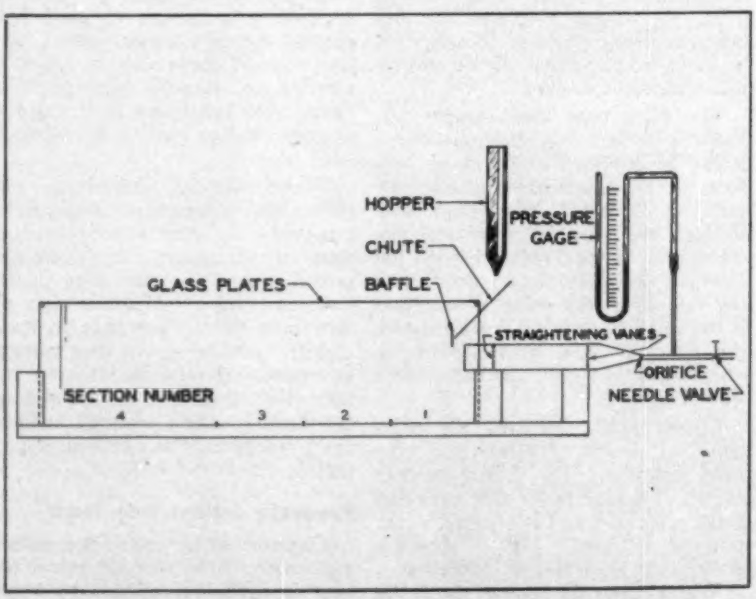


Fig. 5—Sketch of pneumatic sand grader for determining sand settling rates

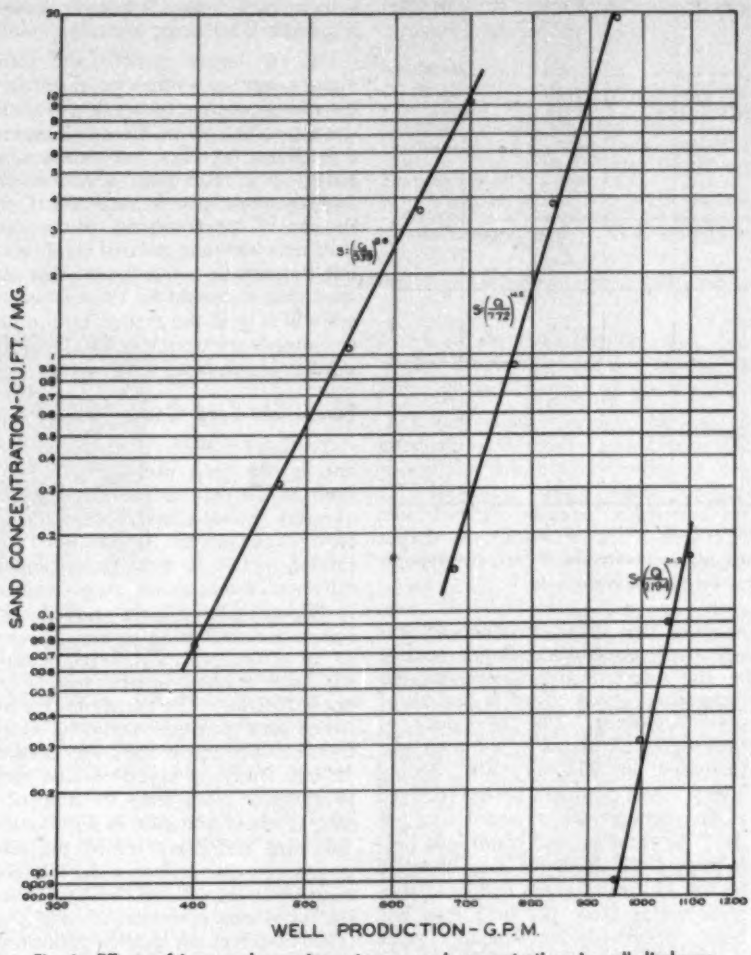


Fig. 6—Effects of increased pumping rates on sand concentrations in well discharge

and immediately after flushing a sand trap than in 24 hours of normal operation. When a well is equipped with a sand tester, sand concentrations may be observed during flushing and either the rate of flushing or the well production may be throttled to meet the exigencies of the situation.

Ridding Mains of Sand

It has been found that even after remedial action preventing the entry of excessive sand into the distribution system has been effected, sand complaints persist for a considerable period of time. Adequate sand control measures must provide for the riddance of sand from the distribution mains in addition to the prevention of further accumulation. In order to carry out an effective flushing program, the behavior of sand in pipes and in networks of pipes was studied by direct observation in the laboratory and by indirect methods in water systems. The literature on this subject deals with single grains of sand[2] or with higher concentrations than are normally found in water.[3]

The hydraulic transportation of sand through pipes is a highly complex phenomenon. The large number of variables involved has impeded both theoretical and experimental investigations. Basically, at very low water velocities, the sand does not move. As the velocity is increased, the sand collects in ridges in the bottom of the main that are similar to the ripples so often noted on the sandy bottom of streams. These ripples have a flat slope on the upstream side, and a comparatively steep slope on the downstream side. The flow of water rolls sand grains up the flat slope to the crest of the ridge, from whence they fall down the steep slope. The net result of this process is an apparent motion of the ripples in the same direction as the water flow at a rate that is very slow compared to the average water velocity.

As the flow of water is increased, a critical velocity is reached where the sand is picked up in the highly turbulent area immediately downstream from the crest of the ripple. The numerical value of the critical velocity depends upon the size, shape, density and concentration of the particles, the diameter and roughness of the pipe and the temperature of the water. In the smooth bore glass tubes it was about one foot per second, but from observations in actual water systems the scouring velocity appears to be much higher than the foot per second velocity.

Sanded Meters Per Mile of Main	
2" main	10.0
4" main	1.3
6" main	1.1
8" main	0.1

Consumer Complaints Per Mile of Main	
2" main	10.0
4" main	2.7
6" main	1.1
8" main	0.6

At water velocities higher than the critical flow, it was impossible to visually distinguish any difference in concentration between the top and bottom of the glass tube. However, theory demands that the concentration of sand must be greater near the bottom of the pipe than near the top. To determine the importance of this effect, taps were made in the top and bottom of an eight-inch main about 30 feet from the nearest fitting. The water velocity was 5 feet per second and sand concentrations ranged from 0.004 to 0.020 cubic feet per million gallons. The sand concentration at the top of the pipe was found to be about 70 per cent of that at the bottom of the pipe, and the sand from the top of the pipe showed appreciably more fines than at the bottom.

Study of Sand Travel in Mains

As might be expected, the flow of sand in distribution systems is vastly more complicated than in straight smooth bore tubes. In order to study the behavior of sand in pipe grids, sand was introduced into a network of glass tubes. These laboratory observations were supplemented by studies of sanded meters and consumer complaints.

The most significant phenomenon observed in the glass model occurred when the water flow rates were adjusted so that the sand flowed in ripples as described above. When one of these ripples traveling down a large tube passes an intersection where a smaller tube tees off, a relatively low flow in the side tube will disrupt the ripple and a disproportionately large

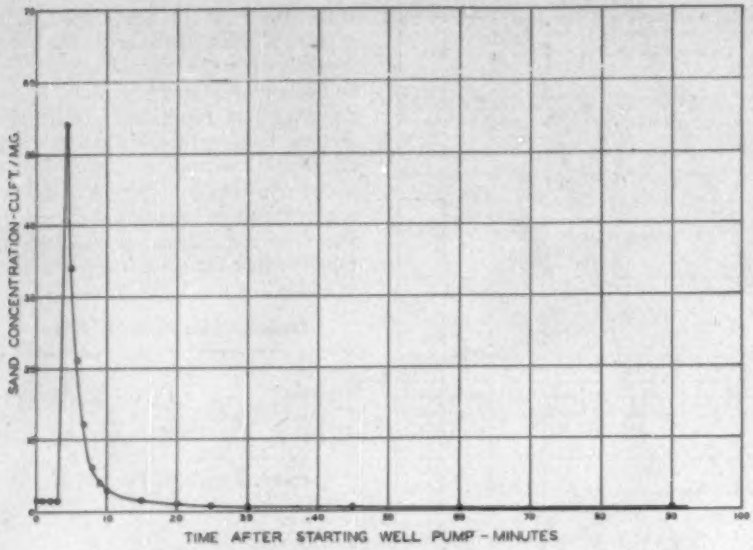


Fig. 7—Relationship between service time and sand concentration of well discharge
Note high concentration of sand during first five minutes

fraction of the sand will enter the side tube. This observation indicates that more sand troubles should be found in the smaller mains of a distribution grid. Studies of sanded meters and consumer complaints confirmed this as is shown in the accompanying table.

The data for sanded meters and consumer complaints were taken from two different communities and the time periods over which data were collected arbitrarily chosen so that in each instance, the number per mile of 2" main would be 10.0. These studies also indicate that sand difficulties are somewhat more prevalent on dead end mains, and there seems to be a tendency for sand difficulties to be more pronounced in low spots in the distribution system, but the effects are secondary and difficult to evaluate.

Main Flushing Requirements

When establishing flushing programs to alleviate sand troubles, the natural tendency is to place emphasis on flushing the smaller mains where the bulk of the complaints originate. As the behavior of sand in the distribution system became better understood, it was realized that the sand complaints from the small mains were merely evidence that sand had first accumulated in the large mains feeding the smaller mains. The first practical test of this theory was spectacularly successful. Sand troubles had developed in a portion of a distribution system supplied from a number of wells. Sand testers showed that only one well was responsible for the troubles. This well was immediately throttled, and a continuous record showed that sand production was effectively controlled. Sand troubles in the affected area continued undiminished, even after a period of several months. The frequency of flushing small mains in the area was increased but had very little lasting effect. Sand complaints were received at an average rate of about five per day. As soon as load conditions permitted, a 12" blow-off was installed on the 12" main which had been supplied water from the well that had been previously producing sand. After flushing this arterial main no sand complaints were received for three days. During the next thirty days, only six complaints were recorded from the area. This main is now flushed annually, and complaints from this area are rare.

Unfortunately, it hasn't always been possible to get such satisfactory results. It is sometimes impossible to find locations where the large flow of water required to adequately flush large mains can be disposed of. Flushing velocities should be at least 5 feet per second, and preferably higher. The total volume of water required should be about 10 times the volume of the main so that for a velocity of 5 feet per second, a main should be flushed for 3⅓ minutes for each hundred feet of length. On a 12" main, 1000 feet long, the required flow would be a minimum of 1800 gpm for a period of 33 minutes, requiring a total of 60,000 gallons. Where it is not possible to get rid of the entire quantity of water, it is more effective to flush at the required velocity for a shorter period than it is to reduce the velocity. It is doubtful if a flushing velocity of less than 5 feet per second is of much value in removing sand.

On the larger mains, sand complaints may sometimes be eliminated by changing the consumers' tap to the top of the main. On small mains, this affords no relief, but considerable reduction in sand may be obtained by feeding these mains vertically from the top of larger mains. Such practices may alleviate isolated conditions, but it must be remembered that the sand that is missed by these consumers will stay in the system until other consumers are troubled, or less likely, until it is removed by flushing.

Permissible Sand Concentration

To make full use of the sand testers, it has been necessary to set a limit on the permissible concentration of sand. Studies have been made relating consumer complaints and sanded meters to sand production in different communities. Approximately 80 wells have been studied with somewhat conflicting results. In view of the difficulties encountered in making such studies, erratic results are not surprising. The great time lag between sand production and its ill effects must be given due consideration. In one study, it appeared that sand progressed from zone to zone at a rate of about one mile in six months. The size and character of the sand grains may also influence the tolerable concentration. Nevertheless, where the sand concentration is less than 0.10 cubic feet per million gallons, no sand troubles have been found, while where the sand concentration exceeds 0.30 cubic feet per million gallons, consumer complaints or sanded meters invariably result. A purely arbitrary limit of 0.10 cubic feet per million gallons has been selected as a tentative limit.

What the Work Has Led To

This work has led to the adoption of routine practices for controlling sand. Centrifugal sand testers are installed on all wells delivering water to the afflicted area to establish which wells are excessive sand producers. Sand concentrations are reduced by (1) changing from intermittent to continuous well operation, (2) curtailing water production, or (3) installing a sand trap. The proper choice of methods for sand control may be facilitated by further tests using the filter type of sand sampler, and if a sand trap is required, the settling rate of sand must be determined.

After controlling sand production from the wells, a study of the distribution system is made to determine

where sand may have accumulated and to affect a means of ridding it from the system.

Consumer complaints have been fewer by about 50 per cent since this program has been in effect, while before that, they were increasing rapidly. It is believed that the incidence of stuck meters, which has been reduced by 82 per cent, is a better indication of the effectiveness of the measures adopted.

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(3) Christensen, N. A. "Report on the Development of a Centrifugal Type Separator by the Means of Models" U. S. Department of Agriculture, Soil Conservation Service Cooperative Laboratory, California Institute of Technology, January 4, 1938.

(4) Ippen, A. T. and Verma, R. P. "The Motion of Discrete Particles Along the Bed of a Turbulent Stream"—Proceedings of the Minnesota International Hydraulics Convention—page 7, International Association for Hydraulic Research, 1953.

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Correction: Stanley M. Dore Is a New Yorker

In our January issue, reporting the N.E.W.W.A. 72nd Convention at Poland Spring, Maine, we used the above photograph of Stanley M. Dore, retiring president of the association. Mr. Dore was incorrectly identified as the Deputy Chief Engr., Allegheny County Sanitary Authority, Pittsburgh, Pa.

Since September 1, 1952, Mr. Dore has been Deputy Chief Engr. of New York City's Board of Water Supply. We regret that the error was made and extend our apologies to Mr. Dore.

Havens and Emerson Announce Changes in Organization

Havens and Emerson, Consulting Engineers with offices in Cleveland and New York City, have recently announced several changes in the organization of the firm.

Frank C. Tolles has retired as an active partner and is retained as a consultant to the organization.

Frank L. Palocsay and Edward L. Ordway have been admitted as partners.

Alvin M. Mock and Glen H. Abplanalp have been advanced as principal engineers.

J. J. McCarthy, Racine's Veteran Chemist, is Dead

Dr. John J. McCarthy, superintendent of water purification at Racine, Wisconsin, for nearly 30 years, died on January 15th, while undergoing an operation. For 30 years he had been in charge of the laboratories of the City Health Dept. and Water Dept. Chemist for almost as many years. He was 61 years old.

A native of Chicago, he was a graduate of Northwestern University —and the Rockefeller Institute. Before becoming City Chemist for Racine, he had operated a medical research laboratory in Milwaukee and thereafter was Director of Laboratories at St. Luke's Hospital in Racine. In World War I he served as a Second Lieutenant in the Sanitary Corps. and was a member of the American Legion.

"Doc" McCarthy was active in the Am. Water Works Asso., was a past-chairman of the Wisconsin Section, active in committee work, and had been voted the George W. Fuller Award in 1953 for presentation at the 1954 Convention. He was a founder and leader in the West Shore Water Producers Assn. He was a member of Racine's Kiwanis Club. Surviving him are his widow and two daughters.

Southern Wastes Conference At Houston in April

This year the Manufacturing Chemists' Assn. is joining with the Southern Assn. of Science and Industry and the Texas Chemical Council in sponsoring the 1954 Southern Industrial Wastes Conference at Houston, Texas. The joint meeting will be held at the Shamrock Hotel on April 21 to 23.

The conference will feature a number of outstanding papers and speakers. Dr. A. P. Black, President of the Southern Assn. of Science and Industry, will present "A Rational View on the South's Pollution Problem." There will also be a paper on "The Interdependence of Man and Earth," by Dr. C. K. Banks, Vice-Pres., Metal and Thermit Corp. Dr. William E. Rand, Director of Research at Stanford Research Institute, will speak on "Industry Planning and Responsibility for Control of Air Pollution."

For a copy of the preliminary program and any additional details, write to James D. Kittelton, Secy., Manufacturing Chemists' Assn., Inc., 1625 Eye Street, N.W., Washington 6, D.C.

H. A. Van Norman Is Dead

H. A. Van Norman, an illustrious engineer and one of the chief builders of the Los Angeles Owens Valley Aqueduct, is dead. He was 75 years old.

Born in Victoria, Texas, his family located in California in his fourth year, making him almost a native son. He joined the Los Angeles Dept. of Water & Power in 1907 as assistant to the redoubtable William Mulholland whose living monument is the water supply system of Los Angeles. He rose from the position of Construction Supt. to succeed Mulholland as Genl. Mgr. and Chief Engr. of the Los Angeles Dept. of Water & Power in 1929. From 1923 to 1925 he was also in charge of design and construction of Los Angeles' main outfall sewer. In 1944 he retired but continued to serve in an advisory capacity.

Mr. Van Norman was past chairman of the Calif. Section of A. W. W. A. and served on the A.W.W.A. Board of Directors later. He was past president of the Los Angeles Chapter Am. Soc. Civil Engrs., the L.A. Section Natl. Assn. of Steam Engrs., and the L.A. Municipal League. He was a 32nd degree Mason. The Van Normans had no children and his wife preceded him in death by only a few months. He died on Jan. 16th as the result of a heart attack.

A.W.W.A. Board Actions--1954

Maffitt choice for president; Amsbary for vice-president. Diven Metal voted to Orchard; Goodell Prize won by Taras. Honorary Memberships bestowed on Newkirk, Thompson and Morrow.

THE forty-member 1954 A.W.W.A. Board met in New York City on January 17-19, with but one absent member. The Board learned that A.W.W.A. membership growth in 1953 had been exceptional, wherein the net member gain of 543 in 1953 represented the greatest growth in 25 years, except in the year 1949 when the growth figure was 639 members. Total membership at the year's end constituted a new record of 9,460 members.

Morrison Cunningham
President

Dale Maffitt
Pres.-Elect

Officers for 1954-55

An early order of business was the choice of officers for the year 1954-1955 by the Nominating Committee of the Board. Such committee consists of the board members elected to represent the various sections. The following choices were made by the Nominating Committee. Unless there are other nominations filed prior to March 1st by the membership-at-large, the official nominees are declared elected as of March 1st to take office at the close of the Annual Convention in Seattle, Wash., May 23-28, 1954.

FOR PRESIDENT:
Dale L. Maffitt, Genl. Mgr.
Des Moines Water Works,
Des Moines, Iowa

FOR VICE-PRESIDENT:
Frank C. Amsbary, Vice-Pres.
Illinois Water Service Co.,
Champaign, Ill.

FOR TREASURER:
Wm. W. Brush, Editor,
"Water Works Engineering"
New York, N.Y.

(Mr. Brush was chosen for his 28th consecutive year as Treasurer of the Association.)

Honors and Awards

The following awards were made—THE DIVEN MEDAL: to Wm. J. Orchard, Gen'l Mgr. for Wallace & Tierman Co., chosen as "that member rendering an outstanding service to the Association." The citation reads:

"In recognition of his many years of devotion to the Association and to the water supply industry; for his remarkable discretion, bold approach, and inspiring enthusiasm in the promotion of its broadening objectives; for his genius as a person which has endeared him to his associates and promoted so much good will and understanding between the producers and consumers in the water supply field."

THE GOODELL PRIZE: to Michael J. Taras, Research Chemist, Dept. of Water, Detroit, Mich., as "that member who has made the most notable contribution to the science or practice of water supply, development, as recorded in a published paper in the A.W.W.A. Journal during the year." The citation reads:

"For his paper, entitled 'Effect of Free Residual Chlorination on Nitrogen Compounds in Water,' which was published in the January issue of the Journal. This paper is a report on fundamental research at Detroit of the effect of chlorine on specific chemical compounds with special reference to surface waters subject to sewage pollution and to ground waters. The paper is a valuable addition to the understanding of the chlorination process—so important to the water works industry."

THE HILL CUP: to the Southwest Section, as "that Section recording the most noteworthy growth in membership during the year." Second position was won by the Pacific Northwest Section.

THE HENSHAW CUP: to the Pacific Northwest Section, as "that Section recording the highest percentage of its members in attendance at its annual meeting." In second place was the large (1056 member) California Section, which retains the famed "Old Oaken Bucket" as the largest section of A.W.W.A.—and, still growing. The rapidly growing Southwest Section, now with 915 members, was recognized for its prowess. Taking second position from the 738 member New York Section, the doughty Southwesterners are now breathing hard on the neck of the Californians.

Three Made Honorary Members

The Board elected the following three illustrious members to Honorary Membership.

Samuel Frank Newkirk, Jr.
Engr. & Sup't.,
Board of Water Commissioners,
Elizabeth, N.J.

"A distinguished citizen of his community and one who has served the Association well for many years—President 1945;

Frank C. Amsbary, Jr.
Vice-Pres.-Elect

W. W. Brush
Treasurer

Vice-President 1944; Director 1938-41. Awarded the Diven Medal in 1942 and the Fuller Award in 1943. Active in committee work throughout the years and outstandingly so in his leadership of the Meter Committee since 1938 during which time the very fine series of five Meter Specifications was promulgated."

Leonard Newton Thompson,
Engr. & Genl. Mgr.,
Water Department,
St. Paul, Minn.

"A valuable member of the Association since 1929. President 1946; Vice-President 1945; Director 1936-39 and again elected Director of the Minnesota Section for the 1954/57 term. Presently serving as Secretary-Treasurer of the Minnesota Section. Received the Fuller Award in 1949. Served on numerous committees and a participant in Divisional activities of the Association."

Ben Stogden Morrow,
Engr. & Genl. Mgr.,
Bureau of Water Works,
Portland, Ore.

"Genuinely admired and beloved throughout the Pacific Northwest. Loyal member of the Association since 1926. Director 1932-35. Received the Fuller Award in 1940. Served on several committees and at the present time serving on the Committee on Watershed Protection and Erosion Control."

50 Year Assoc. Member Firms to be Honored

Upon recommendation of the General Policy Committee A.W.W.A. is

to give special recorgnition to those companies which have been associate members of the Association for half a century or longer. Evidence of this long tenure will take the form of Gold Certificates which are to be presented at the 1956 (75th Anniversary) Convention of A.W.W.A. to be held in St. Louis, Mo., birthplace of the Association. A goodly number of those to receive the certificates will have then been associate member firms for 50 to 73 years.

The Board also voted to consider all persons representing cities or departments, as Corporate member representatives, as being eligible to "Life Memberships" after the required 30 years of such representation. However, the Corporate member (political subdivision, department, etc.) will not be excused from paying dues, as are the Life Members who have maintained a personal (active) membership for 30 years.

More Awards for Noteworthy Papers a Possibility

The General Policy Committee felt that some thought should be given to establishing awards supplemental to the Goodell Prize for the single most meritorious paper of the year. The Board considered the feasibility of establishing an award for the most meritorious paper published in the field of each of the four Divisions—namely, the Management, Purification, Resources and Distribution Divisions. The Board agreed in principle with the recommendations. The question has been referred to the executive committees of the four Divisions for consideration and recommendations to the Board at the 1954 Seattle Conference.

Fuller Award Group's Resolution to be Pursued

The two-year-old resolution of the Fuller Award Society again received the attention of the Board. This resolution (memoranda) drawn by the Fuller Award recipients, known as the Fuller Award Society, comprises a series of recommendations to the Board intended to bring about an improved status of public water supply service and, likewise, that of the personnel of the water supply industry.

Although a start in the direction of the objectives of the memoranda was made at the 1953 Conference in a series of addresses by Howson, Cunningham, Weir, Morris and Murdoch, and later featured in issue No. 25 of "Willing Water," the Board felt that ways and means of reaching the objectives of the F.A.S. memoranda should be further investigated. In particular, the objective of obtaining a higher recognition of water service, and more adequate rates for better water utility maintenance and operation, was thoroughly discussed. The question has been referred to the Committee on Water Works Administration (W. R. LaDue, chm.) and the Water Works Management Div. for study through task-forces. These task-groups will explore the several phases of this important problem and recommend appropriate actions which A.W.W.A. may realistically pursue in uplifting the status of water supply service in general.

Wm. J. Orchard
Diven Medal

Michael Taras
Goodell Prize

Samuel F. Newkirk
Hon. Member

Leonard N. Thompson
Hon. Member

Ben S. Morrow
Hon. Member

Awardees and Honorary Members

A.W.W.A.'s Research Program

Secretary Jordan reported on the three major research projects being supported by or sponsored by the Association. In brief he reported as follows:

A field study was made of the effects of various water treatment materials and procedures on the capacity of water mains. It indicates that certain methods of purifying water seriously reduce the ability of mains to deliver. It is therefore proposed to carry on a careful research program in the laboratories of the University of Illinois to ascertain how conditions can be improved. A request has been filed for a grant-in-aid from the National Institute of Health.

A request for another grant has been made to cover an investigation at Michigan State College of the solubility of metallic chromium and cadmium in water, as well as a study of the toxic effects of salts of chromium in drinking water.

A study of the characteristics of asbestos rope for use in jointing cast iron water mains was made during 1953. An A.W.W.A. specification for such material will be prepared.

Other research, less well organized, is under way or contemplated.

Conditions of Employment to Receive Study

The Board approved the recommendation from A.W.W.A.'s headquarters office that a survey of the conditions of employment in the water works industry, with particular reference to member employment conditions, be made with A.W.W.A. funds.

During 1953 the tabulation and analysis of operating revenues and expenditures in U. S. water works were published. The material has already proved to be of value in many ways, especially as a basis for adjustment of water rates.

In 1954 it is proposed to develop information concerning education, prior experience and earned income of A.W.W.A. members. This survey will also include questions related to union organizations in water works, civil service coverage, pension and retirement programs, etc.

Bearing no personal identification, the returns will be tabulated and analyzed by States and by sizes of cities where employed. This should serve to produce greatly desired answers to questions concerning proper salary level for water works employees.

The Highway Relocation Problem

The Board heard Secretary Jordan review the question of unfairness to water, gas and electric utilities in the matter of forced expenditures by the utility group for relocating mains and other water works structures when through highways are relocated or regraded. For realistic facts, and what the costs are doing to water utilities, he referred to the October 1953 issue of "Willing Water," published by A.W.W.A.

The second session of the 83rd Congress is now giving consideration

to new and improved highway legistion. The utilities case is a sound one, since they operate for the public benefit. Therefore, the first step in remedying the inequity should be the passage by Congress of an act providing for reimbursement of utilities put to relocating expense. Such an act would settle the question of how the costs are paid and by whom. At present there are widely differing decisions in the various states enjoying federal aid in highway construction.

Bills to give utilities relief are now being considered by committees in the House and the Senate. Naming the members of each committee, Secy. Jordan asked that all water works men appeal to members of Congress for support of the utility relief bills now in committee.

Water Works Administration Report

Chairman, W. R. LaDue, presented an interesting report covering activities and plans of his Committee on Water Works Administration. Space limitations preclude doing justice to the report, which is to appear in full in the March 1954 issue of the A.W.W.A. Journal.

One item of wide interest is the activation of a special committee to study and report on the growing practice of diversion of water works income to other city uses. The practice is becoming increasingly prevalent and more serious, because of increasing costs of other services rendered by cities without adequate tax income to maintain such services.

Water Works Practice Report

Chairman, Louis R. Howson, presented his customary "stop—look and listen" type of report of the Committee on Water Works Practices,

"Wheel-Horses"

Louis R. Howson (W. W. Practice)

Wendell R. LaDue (W. W. Administration)

now embracing 391 members taking part in one or another phases of its work. Again, space limitations preclude doing justice to Howson's report which, like La Due's report, should be read in full in the March 1953 issue of the A.W.W.A. Journal. A few highlights follow:

Much needed "Specifications for Lining Water Mains in Place" are practically ready now for publication. The Committee on Water Meters is being re-organized under J. G. Carr's (Am. Water Works Service Co.) as chairman. A new committee will study the effects of modern synthetic detergents on water treatment procedures and plant performance. Detergents have adversely affected the performance of a number of water treatment plants during the year and counter measures are sorely needed.

(For experiences at the Wheeling, W. Va. Filtration Plant, see the report by A. R. Todd in our February issue.)

A "Manual of Water Treatment Plant Design" will be produced by a joint committee of A.W.W.A. and A.S.C.E. under chairmanship of Ray L. Derby of Los Angeles.

Lack of Funds Crippling

Secretary Jordan pointed out that rising costs of almost everything, except A.W.W.A. dues which had been the same $10.00 per year since 1927, had forced the A.W.W.A. office to consider the outlook. That expenditures would exceed income in 1954. Rather than hazard the possibility that a deficit of size might become the "cold truth" before year's end, some proposed and desirable activities of A.W.W.A. had been held out of the proposed 1954 budget, as presented to the Board for approval.

The Board approved the 1954 budget, but also instructed the Finance Committee to study the Association's finances and future, with the thought that some increase in annual dues above the $10.00 figure established in 1927 might be mandatory in the general interest of the Association and its membership, served so effectively during Secretary Jordan's regime.

Miami Meter Reader Cited for Heroism

Salvatore Bunetta is a meter-reader in the Miami, Fla., Dept. of Water & Sewers. Recently while on his route, reading meters, he heard the cries of a drowning Negro boy in Biscayne Bay. Into the bay Salvatore leaped fully clothed and rescued the boy. As a result, he found himself on the front page of the newspapers.

The Miami Water and Sewer Board, having learned of Salvatore Bunetta's heroic deed, took note of it by passing "Special Resolution No. 416" commending Bunetta "for his heroic conduct and valorous action." Supplementing the official commendation, Bunetta was presented with a Longines wrist watch and band which bears the inscription—"For heroic conduct—presented to S. M. Bunetta by the Miami Water & Sewer Board."

Rutgers Univ. Announces New J. V. N. Dorr Fellowship

In commemoration of the 50th Anniversary of the invention of the Dorr Classifier by Dr. John Van Nostrand Dorr, a graduate fellowship has been established by the Dorr Company through the Dorrco Educational Trust, founded for educational and scientific purposes, for the benefit of the public. The fellowship for the year 1954-55 is offered at Rutgers University in the Department of Sanitation.

The fellowship is open to citizens of the United States or Canada holding Bachelor of Science or Master of Science degrees. Properly qualified candidates with training in any of the following fields of science are eligible: chemistry, biochemistry, biology, bacteriology and civil, sanitary or chemical engineering.

The appointment is on a 12 month basis beginning Sept. 1, 1954. The stipend is $1800 per year, plus tuition and one month vacation is allowed. Applications are due by April 1 and the award will be made about April 15.

Applications, forms and further details, may be obtained from:

Dr. Harold E. Orford, Head,
Department of Sanitation
Rutgers University,
New Brunswick, N. J.

In addition, a number of other fellowships are available for men with the same qualifications.

Citrus Waste Treatment Studies

Laboratory development of aerobic methods involving added nitrogen or "super-activated" sludge

by ROSS E. McKINNEY, LEON POLIAKOFF and RUSSELL G. WEICHLEIN*

Summary

Laboratory studies on the treatment of citrus cannery wastes have shown that a conventional activated sludge process can stabilize 99 per cent of the 5-day B.O.D. in a 5-hour aeration period if the nitrogen deficit has been overcome by added chemical nitrogen. It is possible to develop an activated sludge from nitrogen-fixing bacteria which will remove 99 per cent of the 5-day B.O.D. in 6 hours of aeration without the addition of chemical nitrogen. The "super-activated" sludge process, however, is not as applicable as the conventional activated sludge process in treating this waste.

THE disposal of waste waters from citrus canneries has long been a problem in the field of industrial waste disposal. Citrus cannery wastes are restricted primarily to Texas, Florida and California; for the most part, research to determine a satisfactory method for their disposal has been directed toward solving the particular pollution problems created in each of the three areas.

As the public demand for citrus products has increased, the pollution problems also have increased. The disposal methods previously used are no longer adequate, and the pollution problem has become acute in areas surrounding citrus canneries.

Texas

In Texas the citrus industry is concentrated in the Rio Grande Valley. The canneries are concerned primarily with canning grapefruit juice and sections as well as orange juice. As the seasons change, the same canneries pack tomatoes and beans as well as other products produced in the Valley. Waste disposal facilities must be designed to handle loads of varying characteristics. Most of the canneries are small and are operated on a small margin of profit. Accordingly, the canneries cannot afford costly disposal facilities. The lack of available land hinders the construction of extensive treatment plants for these wastes.

Florida

The demand for frozen citrus products has created a new industry in Florida within a relatively short period of time. To meet this demand, canneries have become larger and larger. At the same time, the volumes of wastes produced have become larger. With the increased size of the canneries, the waste disposal problem has become easier in many instances: the large canneries produce a sufficient volume of wastes to economically recover a large portion of them by drying for use as cattle feed[1]. This practice has not completely solved the waste disposal problem, however, as there are many small canneries which cannot economically treat their wastes in this manner.

California

In California the problem is quite similar to that of Texas. Water is very scarce and the recovery of any waste waters is imperative. But here, in many instances, land is not at a premium as it is in Texas. Ludwig et al[2] have reported on the disposal of citrus cannery wastes in California by land adsorption. The soil in the area around Ontario, Calif., permits rapid adsorption of the liquid while retaining the complex solids on the surface in a thin layer. The organic matter is periodically turned into the soil where it undergoes further decomposition. The liquid portion makes its way into the underground water table where it is vitally needed. The organic matter is recovered through farming on the disposal areas.

The disposal problem remains unsolved in all three areas for the small citrus canneries. It is for them that most of the research has been conducted. Work has been carried on primarily by the Citrus Commissions and the State Health Departments of Texas, Florida and California as well as by the U.S. Department of Agriculture in conjunction with the citrus industry.

Biological Treatment

The disposal of dilute liquid wastes has centered around the normal biological disposal processes. Von Loesecke[3] has recently reviewed the entire subject of biological disposal of citrus wastes. Although trickling filters were not successful in treating the wastes in Texas, he found that they were successful in treating wastes in Florida. In Texas the filters developed septic conditions with loads as low as 1.0 mil. gal. per acre per day.

Von Loesecke[4] obtained 54.6 to 88.4 per cent B.O.D. removals on an 8-ft. deep filter, applying a waste having a B.O.D. of 633 to 876 ppm. When the nitrogen content of the waste was increased by adding nitrogenous compounds, the efficiency of the process increased also. But this was not considered an economical means of treating the wastes.

Anaerobic fermentation methods have been tried with limited success. Studies of activated sludge and contact aeration processes have been unsuccessful. The primary reason for the failure of the biological processes to successfully stabilize the citrus waste is its lack of nitrogen content.

*The studies reported by Messrs. McKinney, Poliakoff, and Weichlein were carried out in the Dept. of Sanitary Science, Southwest Foundation for Research and Education, San Antonio, Texas. Mr. McKinney is presently in the Dept. of Civil and Sanitary Engineering, Mass. Inst. of Technology, Cambridge, Mass.

This investigation was supported in part by a research grant, E-269, from the National Microbiological Institute of The National Institutes of Health, Public Health Service.

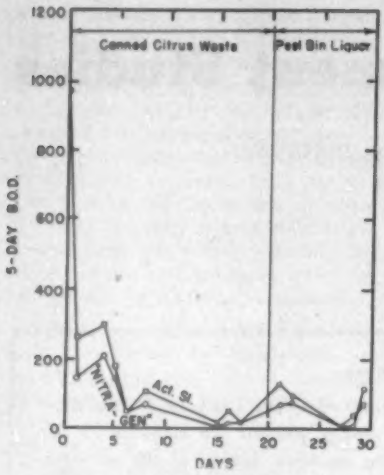

Fig. 1—EFFLUENT B.O.D.
Conventional activated sludge units

A typical analysis of a citrus cannery waste is given by Von Loesecke[3].

Total solids = 672 to 4084 ppm
Dissolved solids = 501 to 3836 ppm
Total nitrogen = 8 to 15 ppm
5-Day B.O.D. = 343 to 2000 ppm
pH value = 5.6 to 7.2 ppm

The high cost of adding supplemental nitrogen has been the stumbling block to the use of the biological processes for stabilizing the citrus wastes.

Recent work has been performed under the direction of C. H. Scherer of the Texas State Health Department at the Citrus Waste Research Project's pilot plant, Donna, Texas. These studies indicated that it was possible to form an activated sludge which could successfully stabilize citrus waste without the addition of chemical nitrogen. The following research was conducted to determine if it is possible to readily form such an activated sludge, and to determine the biological and biochemical characteristics of this sludge.

Theoretical Considerations

The stabilization of an organic waste by biological methods results from the metabolic activities of the bacteria in the system. The reaction which takes place in an aerobic system is as follows:

$$\text{bacteria} + \text{organic matter} + O_2 \rightarrow \text{new bacteria} + CO_2 + H_2O + \text{energy}$$

This reaction is dependent upon the condition of the system. It is altered by changes in the organic matter, aeration period, pH, oxidation-reduction-potential, dissolved solids, dissolved oxygen, amount of returned sludge, sludge age and inorganic salts.

For this equation to proceed at its maximum rate, there must be an excess both of nitrogen and of phosphorus. In a deficiency of nitrogen the bacteria in the aeration system are unable to multiply. It is during the bacterial growth phase that maximum removal of the organic matter occurs. When bacterial growth is not taking place, only a small amount of organic matter is required by the bacteria for energy. In a deficiency of phosphorus the bacteria are unable to transform the organic matter into the energy-producing compounds necessary for the bacteria to carry out their normal metabolic functions.

The deficiency of nitrogen in citrus wastes prevents them from being a suitable medium for rapid bacterial growth and hence prevents rapid stabilization of the waste. If activated sludge is to be produced from citrus waste, nitrogen must be present. If chemical nitrogen is not added, the only other potential source of nitrogen is atmospheric nitrogen. Normally atmospheric nitrogen is unavailable, since most bacteria do not have the biochemical systems necessary for its utilization. A few bacteria, found in soil, have the ability to obtain their nitrogen from the air around them. The production of activated sludge in nitrogen-deficient citrus waste would constitute evidence of the existence of nitrogen-fixing bacteria within the sludge.

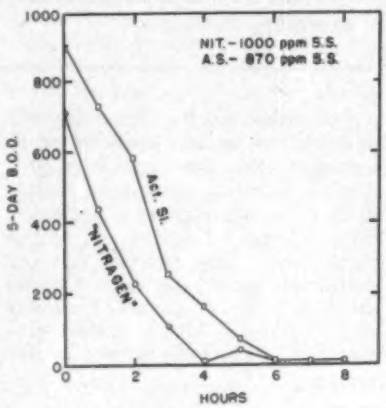

Fig. 2—EFFLUENT B.O.D., 8th day
Conventional activated sludge units

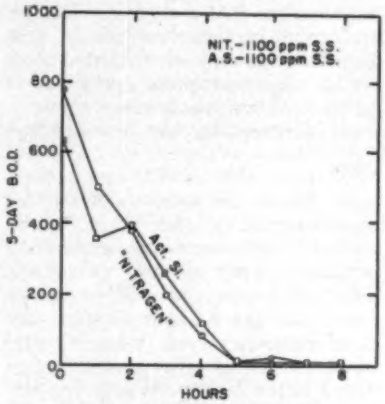

Fig. 3—EFFLUENT B.O.D., 16th day
Conventional activated sludge units

Materials and Methods

The source of the nitrogen-fixing bacteria used in this study is a commercial product, Nitragen, which is used to inoculate legume seeds before planting. Nitragen contains both the symbiotic, *Rhizobium*, and the non-symbiotic, *Azotobacter*, bacteria in a dessicated state. The nitrogen-fixing units in each of two studies were seeded with one gram of Nitragen. These seeded units will be referred to throughout this paper as Nitragen units.

The Nitragen units were compared with a normal activated sludge control which was started from sewage seed. The nitrogen deficiency was satisfied in the control unit by adding chemical nitrogen in the form of ammonium sulfate.

All experiments were conducted as a batchwise process, using gallon jugs as aeration units. These units were operated as similarly as possible to a conventional activated sludge system. Each aeration unit contained three liters of mixed liquor. At the end of the aeration period one liter of mixed liquor was wasted, the remaining two liters of mixed liquor were allowed to settle for one hour, and at that time one liter of the settled supernatant was poured off. Two liters of fresh waste were added and aeration was then started. The systems were operated on a 23-hour aeration cycle.

"Super-activated" Sludge

In addition to the normal activated sludge units, a second system was studied. This system is called "super-activated" sludge and was developed at Southwest Research Institute to treat wastes high in organic matter. The aeration units also were gallon jugs and contained three liters of mixed liquor. At the end of the aeration period, 0.2 liter (200 ml) of mixed liquor was wasted. The remaining 2.8 liters were allowed to settle for one hour. At that time, 1.8 liters of the settled supernatant were filtered through a cotton towel to remove any large non-settleable solids. The supernatant was replaced in the aeration tank and 0.2 liters fresh feed was added.

The major differences in the two systems were the concentration of feed, the amount of sludge wasted and the amount of supernatant recirculated. Although the concentration of the citrus wastes fed to each system differed by a factor of ten, the concentration of wastes in the aeration units was the same, since the volumes of feed also differed by a factor of ten. This permitted a comparison to be made of the relative efficiencies of the two systems.

Experiments—First Series

In the first series of experiments only the conventional activated sludge units were used. The feed to these units was prepared by diluting canned citrus juice 1:49 with tap water. This synthetic waste had a 5-day B.O.D. of 1220 ppm. In order to help neutralize any excess acids which might be formed during the normal metabolism of the citrus waste, 300 ppm of sodium bicarbonate were added.

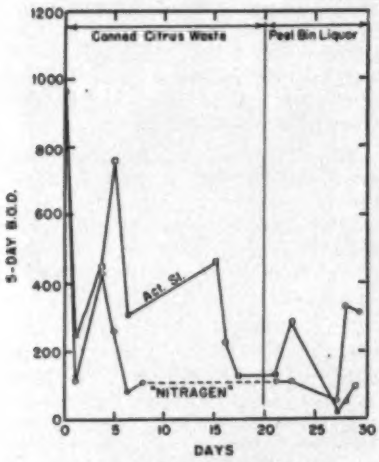

Fig. 4—EFFLUENT B.O.D. "Super-activated" sludge units

The nitrogen deficiency in the control unit was satisfied by adding 400 ppm of ammonium sulfate, which gave a B.O.D.:N ratio of 15:1. In addition to the nitrogen, 200 ppm of dibasic potassium phosphate was added to help buffer the substrate and to furnish additional phosphorus if necessary.

Two Nitragen units were set up. Both units contained the 300 ppm of sodium bicarbonate but only one unit contained the 200 ppm of potassium phosphate.

The units were operated according to the procedure already outlined. At the end of the seventh day, samples were taken of the effluent and tested for B.O.D. The loading was increased to 1610 ppm B.O.D. per day. Effluent samples were taken on the 15th day and the loading was increased to 1830 ppm. On the 22nd day samples were taken and the loading was increased to 2400 ppm. After four days of operation, the sludge began to disintegrate in each of the units. A check of the pH of the units indicated a pH below 5.0. Operation of all units was stopped.

Experiments—Second Series

The second series of experiments was run using both the conventional units and the "super" units. Canned citrus waste was used as feed for the first 20 days, and then peel bin liquor was used until the end of the run. The canned citrus waste was prepared by diluting canned citrus juice 1:49 with water.

This waste was buffered to a pH of 6.9 by adding phosphoric acid and sodium hydroxide. In the control unit the B.O.D.:N. ratio was adjusted to 15:1 with ammonium chloride. The 5-day B.O.D. of the waste was 1450 ppm.

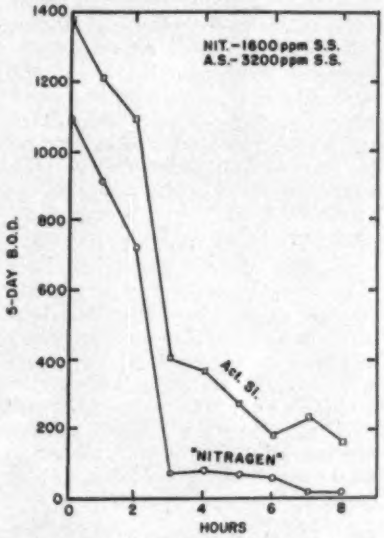

Fig. 5—EFFLUENT B.O.D., 8th day "Super-activated" sludge units

The waste fed to the "super" units was prepared in a similar manner, the waste used being ten times the concentration fed to the conventional units.

The units were operated in the manner previously outlined. Samples of the effluent were taken at regular intervals and tested for B.O.D. On the eighth and 16th days samples were taken at hourly intervals and the B.O.D. value was determined. Suspended solids also were determined at the start of each of the hourly sampling periods. Microscopic examinations were made at regular intervals to determine the floc characteristics.

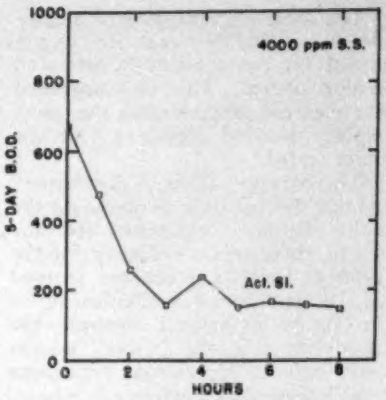

Fig. 6—EFFLUENT B.O.D., 16th day "Super-activated" sludge units

Results

The results of the first series of experiments are shown in Table 1. The optimum efficiencies were obtained on the 15th day of aeration. The Nitragen unit without additional phosphorus showed 97.6 per cent B.O.D. removal in 24 hours aeration. With additional phosphorus the B.O.D. removal of the Nitragen unit was increased to 98.5 per cent. The control unit with additional nitrogen and phosphorus had a B.O.D. removal efficiency of 99.4 per cent.

Both Nitragen units produced sludge which appeared to be composed of a mixture of bacteria. The majority of bacteria appeared to be *Azotobacter*, while other bacteria were similar in appearance to those normally found in activated sludge. Normal protozoan populations existed in both units.

Second Series

Data on the second series of experiments are shown in Figs. 1, 2, 3, 4, 5 and 6. The 24-hour effluent samples from the conventional units are plotted in Fig. 1, while the hourly samples taken on the 8th and 16th days are plotted in Figs. 2 and 3. The 24-hour effluent samples from the "super" units are plotted in Fig. 4, and the hourly samples are plotted in Figs. 5 and 6.

Table 1

EFFLUENTS FROM ACTIVATED SLUDGE UNITS TREATING CITRUS WASTES

Unit	Nutrients	5-Day B.O.D. 7th Day	15th Day	22nd Day
Nitragen	—	136	40	260
Nitragen	P	76	25	165
Activated Sludge	N+P	17	11	31

These Units Receive Citrus Waste at 24-hour Intervals.

The Nitragen unit showed an efficiency of 99.9 per cent B.O.D. removal for the convention activated sludge system. This unit produced the clearest effluent and the most rapidly settling sludge of all the units tested.

The Nitragen units in the "super" system did not fare as well. As the units became acclimated to the waste, there was a tendency for the types of bacteria to change. Instead of the *Azotobacter* predominating as in the conventional system, the *Azotobacter* in the "super" system gave way to filamentous organisms which were not as efficient in removing the organic matter and did not settle easily. This condition prevented samples being taken between the seventh and 21st days of operation. Changing from the use of canned citrus juice to peel bin liquor caused the equilibrium to shift back in favor of the *Azotobacter*. With peel bin liquor, the Nitragen unit produced a compact and easily settling floc similar to that of the conventional units.

The control units with supplemental nitrogen produced 99.9 per cent B.O.D. removal in the conventional system. The effluent was clear and free from color, as was the Nitragen unit. The sludge was typical of normal activated sludge.

The control units in the "super" process never approached the results attained by the control units of the conventional system. The sludge in the "super" units was predominately filamentous organisms resembling *Sphaerotilus*. The effluent was dark brown in color and contained considerable bacterial solids even after settling and filtration. The "super" units all foamed extensively after feeding, while the conventional units foamed only slightly after one hour of aeration.

Discussion of Results

The production of activated sludge and the resultant stabilization of nitrogen-deficient citrus waste is proof of the nitrogen-fixing capacity of the sludge. Although no nitrogen-fixing bacteria were isolated in this study, microscopic examinations of the sludge showed that the majority of the bacteria had the appearance of *Azotobacter*—which are the non-symbiotic nitrogen-fixing bacteria found widely in nature.

The fact that the Nitragen unit was capable of removing organic matter from solution just as rapidly as the control units, while maintaining approximately the same solids concentration, indicates that the nitrogen-fixing bacteria can fix nitrogen from the atmosphere as rapidly as other bacteria can utilize chemical nitrogen in the normal activated sludge system.

Supplemental Nitrogen

Operation of the control unit in the conventional system demonstrated that if supplemental nitrogen is added to citrus waste, a normal activated sludge can be formed. In 5 hours of aeration this sludge can remove 99 per cent of the B.O.D. from a waste having 1450 ppm B.O.D. and 1100 ppm suspended solids. Unfortunately, the extreme lack of nitrogen in citrus cannery wastes makes the addition of chemical nitrogen an uneconomical solution to the waste disposal problem.

"Super-activated" sludge is a process designed to treat small volumes of extremely strong organic wastes through the recirculation of large volumes of effluent and sludge. The recirculation of effluent is designed to lower the B.O.D. of the waste in the aeration tank to a point where it can be rapidly assimilated and to return a large concentration of hydrolytic enzymes. The high solids furnish a large supply of organisms to rapidly stabilize the organic matter.

Although this process has been successful in pilot plant studies treating a highly toxic industrial waste where dilution was necessary to overcome the toxicity, it was not successful in the treatment of the non-toxic citrus waste. It was hoped that the "super-activated" sludge process might provide a means to treat concentrated wastes which could be handled separately.

Nitrogen Fixation

The Nitragen unit results were not compatible at all with those of the "super-activated" sludge system. But in this incompatability, it is possible to see some of the problems that will be involved in the successful use of a nitrogen-fixation system. The recirculation of large quantities of effluent and sludge caused filamentous bacteria to rapidly predominate over the nitrogen-fixing bacteria. A careful examination of the biochemistry of the nitrogen-fixing bacteria indicates a reasonable explanation of this phenomenon.

The nitrogen-fixing bacteria are able to predominate in the system only because there is, for all practical purposes, a complete deficit of nitrogen. If any nitrogen was available, other bacteria would utilize the nitrogen for their metabolism and would at the same time remove the food needed by the nitrogen-fixers. But as the nitrogen-fixers grow, they fix only enough nitrogen to produce fresh protoplasm necessary for their new cells.

As the system ages, there is a breaking down of some of the nitrogen-fixing bacterial cells as well as of other micro-organisms in the system. This breakdown of organisms results in a release of chemical nitrogen into the system. If the nitrogen-fixing bacteria are to continue to predominate, the breakdown of old cells and the release of chemical nitrogen into solution must be held to a minimum. This can be accomplished in the conventional process by constantly wasting sludge and recycling only sufficient effluent to carry the return sludge.

In the "super" unit, the old cells were retained in the system and most of the effluent with its chemical nitrogen content was returned to the aeration unit daily. As a result, there was a gradual decline in the nitrogen-fixers and an increase in the intermediate nitrogen users.

The intermediate nitrogen users are organisms which predominate in the range between normal heterotrophic bacteria and the nitrogen-fixing bacteria. These organisms include certain filamentous bacteria, fungi and algae.

The intermediate nitrogen users took over the "super" Nitragen unit until the peel bin liquor was used as feed. The peel bin liquor contained certain oils and chemical substances which were more readily available to the nitrogen-fixers than to the filamentous organisms. As a result, the biological population shifted back to the nitrogen fixers.

Added Nitrogen

It was readily apparent from operation of the control "super" unit that a suitable floc could not be maintained, even in the presence of ample nitrogen. The environmental conditions set up by this system also permitted the filamentous bacteria to predominate. The addition of the peel bin liquor did not stimulate the normal bacteria as it did the nitrogen-fixing bacteria.

The equilibrium between the filamentous forms and the normal forms never shifted as far in favor of the filamentous bacteria in the control unit as it did in the Nitragen unit. Unfortunately, this study did not permit a complete investigation to be made as to the factors affecting

the predominance of the various types of bacteria in these systems.

Nitrogen-fixing Bacteria in Activated Sludge

The use of nitrogen-fixing bacteria in activated sludge systems is not new. In England, during World War II, studies were made by L. A. Allen[5] using activated sludge principles to produce protein from nitrogen-fixing bacteria. His studies indicated that this method was not practical for producing protein materials. The present study has shown that nitrogen-fixing bacteria may provide an economical solution to disposing of citrus cannery wastes and other nitrogen-deficient wastes.

The literature on nitrogen-fixing bacteria clearly indicates that considerable study is required before a nitrogen-fixing activated sludge system can be made to operate successfully on a large scale. It will be only through a careful study of the nitrogen-fixing bacteria, their biochemistry, and the related factors, that the engineering considerations required for proper design of the disposal system can be evolved.

Acknowledgement

The authors wish to acknowledge the assistance given by C. H. Scherer of the Texas Citrus Cannery Waste Research Project, and by other members of the Texas State Health Department in conducting these studies.

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Los Angeles Installs 500,000th Water Meter

The Los Angeles Department of Water and Power in 1952 celebrated its 50th anniversary as a municipally operated utility. On January 7th of this year another milestone was passed with the installation of its 500,000th water meter.

Los Angeles thereby became the first city in the nation with a half million water meters in service. The nearest contender in number of water meters in service is Detroit with 388,919 meters, followed by Philadelphia with 329,464, Cleveland with 248,000. Of these cities, Los Angeles, Detroit and Cleveland are 100 per cent metered.

Los Angeles' first water meter was installed in 1889 but as late as 1902, when the water system passed from private to municipal ownership, there were only 319 meters on the system.

Less than four years ago the 400,000th water meter was installed in Los Angeles, and since that time more than 25,000 meters per year have been installed, an indication of the high population increase since 1950.

The number of meters installed annually in Los Angeles reflects the traditional policy of pioneer city leaders who demonstrated foresight and long-range planning in conserving the water supply which has made possible Los Angeles' growth.

In the accompanying picture of the installation Geo. Read, retired former Supt. of Meters & Services who installed the first meter under municipal ownership, is passing the 500,000th meter (Neptune No. 11,500,000) to Bob Luce, Water Service & Main Foreman. On the left is Burton S. Grant, Chief Engr. and Asst. Genl. Mgtr. On the right is Samuel B. Morris, Genl. Mgr. and Chief Engr. with Mrs. H. B. Ross for whom the meter is being installed.

About Barthel: Harvard Athlete And Sanitary Engineer

There is a graduate student at Harvard University studying for his Ph.D. in sanitary engineering; his name is Josy Barthel, which is unusual; and it is more unusual that he comes from Luxembourg, Belgium. But it is most unusual that he was the 1952 winner of the 1,500 meter championship in Helsinki's Olympic Stadium.

Barthel stayed out of competition during 1953 because of an inflamed tendon, but he started to train again when he came to Harvard in September of that year. Late in January, 1954, he set a new record for the fastest indoor mile ever run in Boston. In New York, in February, Barthel came through with a fast finishing sprint to win the indoor mile race at the Millrose games meet in Madison Square Gardens.

Flotation and Sedimentation in Treating Wastes

Comparing the use of these processes for removing suspended matter

by **A. A. KALINSKE**, *Director of Research and Development and* **R. R. EVANS**, *Manager, Waste Treatment Department, Inflico, Inc., Tucson, Arizona*

This paper was presented at the Eighth Industrial Waste Conference at Purdue University and is here published by permission.

THE equipment most widely used to effect separation of solids from liquids (or liquids of different densities) depends on the force of gravity to provide the separation. The separation may occur due to *settling* of the material heavier than water or to *flotation* due to its bouyancy. Conventional clarifiers, settling basins, gravity oil separators, etc. are examples of such equipment.

In order to assist in the speed of removal, artificial aids are used many times, either to increase the specific gravity so as to hasten settling, or to decrease the effective specific gravity so as to speed up the flotation process. The rate of settling can be increased by designing special equipment which will produce denser and larger precipitates, or by using various artificial weighting agents. Flotation can be greatly accelerated by attaching gas bubbles to the particles or droplets of foreign matter to be removed.

It is the purpose of this paper to analyze and evaluate the applicability and limitations of the processes of settling and flotation in the removal of suspended matter from liquid wastes.

Clarification by Gravity Settling

Extensive literature gives the general fluid dynamic theory relating to the settling of particles in water, and also describes how this theory can be applied to the design of various shapes of settling basins. In brief, we know that basically the dimensions of any sedimentation basin will determine the settling velocity of the particles being removed. This settling velocity may be that of the individual particles, or of a suspension including the particles, depending on how concentrated the material is that we are removing, and the general hydraulic design of the clarification basin[1]. In any case, specific settling velocities can be determined readily by simple laboratory tests.

In circular or rectangular basins (without using chemical treatment, flocculation or any other measure to densify the particles being removed), simple gravity settling is frequently all that is required to secure efficient and economical solid-liquid separation. In other instances there is an economy in first cost and an increase in removal efficiency if chemical treatment is used to coagulate and agglomerate the suspended material so as to increase its settling rate. Sometimes in addition to the use of a standard aluminum or iron coagulant, it is advantageous to use a coagulant aid or weighting agent such as activated silica, clay or pulverized limestone. It frequently is desirable, both from a first cost and treatment efficiency standpoint, to use a so-called solids-contact treatment unit, both to secure a heavier and more rapidly forming precipitate, and to take advantage of the better clarification possible by enmeshment of the finer particles in the slurry suspension of sludge blanket.

Using Solids Contact Units

An example of a solids-contact unit using a slurry suspension that has been widely used in the chemical treatment of waste waters is the Accelator, and its close relative, the Cyclator (Fig. 1). The latter has proved quite efficient in handling waste waters where the chemical treatment produces large volumes of slow settling precipitate. It provides the advantages of solids-contact and slurry circulation for densification of precipitates and improved clarification, and also of sludge thickening, all in one unit.

To indicate the use of the above type of equipment for treatment of oil-bearing wastes several examples might be cited[2]. Where such wastes contain a very high concentration of emulsified oil together with some free oil, it is desirable from an operational and chemical economy standpoint, to provide a preliminary treatment and holding tank; in that unit, a partial breaking of the emulsion can be accomplished with, for instance, iron sulfate. The oil released by emulsion-breaking, together with the free oil, can be skimmed off before the waste is given its final treatment and polish.

An example of such an installation is a plane-washing waste treatment plant at an Air Force Base. At this plant the preliminary treatment tank serves also as an equalization basin; the variable and erratic nature of this waste makes it imperative that equalization precede any treatment unit, no matter of what type. The preliminary skimming basin is followed by an Accelator in which the high oil content (several hundred ppm) is coagulated with iron sulfate and lime. The effluent produced has an oil content of 10-15 ppm, and is discharged into a small creek used for watering cattle. To increase the density of the oil-bearing floc in this case, limestone is added to the Accelator slurry.

Other examples of similar treatment of oil-bearing wastes could be given, which involve the use of Accelators and Cyclators as the final treating units for wastes at refineries and at various metal-working plants. In general, it can be said that clarification in such treating units will produce a quality of effluent that can be exceeded only by filtration.

Flotation from Air-charged Pressurized Flow

Flotation means the process causing particles or droplets of foreign matter in water to float by the attachment of minute air or gas bubbles to such particles or droplets. This process has been used in the metallurgical field for over a century, and has been developed into a fine art and science in that industry[3].

So far as the metallurgical application is concerned flotation is a

physiochemical process of ore concentration; it utilizes the reactivity of the mineral surfaces for specific organic and inorganic compounds to form gas-adhesive coatings. The gas-adhesive coatings form on particles of one mineral or group of minerals, and water-adhesive coatings form on the others. The gas-adhesive coating permits attachment of the particles to the ascending bubbles, which float them to the surface where they collect as a froth and are separated from the water-adhseive particles remaining in the liquid. The various so-called flotation or frothing reagents are designed to (a) facilitate formation of the bubbles, and (b) selectively form gas-adhesive coatings on certain minerals.

Flotation in Metallurgy

In the metallurgical field flotation usually is accomplished in so-called "cells," each of which utilizes a high-speed impeller. The impeller disperses air put into the cell under pressure or air resulting from the suction action produced by the high-speed rotating impeller. This action draws in and breaks up the air into fine bubbles which rise up through the slurry, attaching themselves to the gas-adheive particles. The air could be introduced through porous diffusers, but experience has shown that in this application diffusers tend to clog rapidly.

Some experimental work has been done utilizing the above described flotation scheme for treatment of sewage[4], and also for clarification of turbid waters[5]. However, because of the high cost of the flotation reagents, practical use of this treatment has been considered uneconomical. For instance, the cost of treating a million gallons of sewage or water may be of the order of $100 to $300 when using a flotation reagent.

Flotation in the Pulp and Paper Industry

Flotation has been in use for many years in the pulp and paper industry in recovering and concentrating fibers. The "Save-all" units employed for this purpose usually operate on the principle of vacuum flotation. After the liquid being treated is saturated with air, it is subjected to a partial vacuum in the treating unit—thus causing some of the air to come out of solution in the form of microscopic bubbles which attach themselves to the fibers and float them to the surface. Usually special reagents or glues are used to facilitate the air-bubble attachment.

A manufacturer of sewage treatment equipment markets a flotation unit operating on this principle for removal of grease and other readily flotable material from sewage. Without the use of a coagulant, about 50 per cent of the suspended material may be removed from sewage in such units.

Flotation in Treating Waste Waters

During the past few years there has been promoted a somewhat different flotation scheme, one which requires relatively simple structures and is quite effective in floating most suspended matter without the use of expensive flotation reagents[6,7]. The general principle involved is treatment of a waste water by adding a coagulant (if necessary) and by pressurizing it with a centrifugal pump; air is sucked in or forced in on the suction side of the pump. The mixture of liquid and air is thus pressurized to about 20 to 30 lbs. per sq. in. pressure, and goes to a 1-minute retention tank to allow the waste to become completely saturated with the air. A special air-release valve is installed on this air saturation tank, so that excess undissolved air can escape. Following the saturation tank, the waste goes to the flotation basin where the pressurized liquid is discharged through a special valve to practically atmospheric pressure. The sudden release of pressure under high velocity conditions causes the dissolved air to come out of solution in the form of microscopic bubbles. The condition is quite similar to that observed when water discharged from a faucet into a glass appears to be milky, and when a suspension of minute bubbles rises slowly to the surface.

In a flotation unit such as the Infilco Sediflotor (Fig. 2) the suspended material is floated to the surface and is skimmed off; any solids too heavy to float will settle and be moved into a sump by the bottom scrapers. If desired, a portion of the effluent can be recirculated and mixed with the raw waste; under

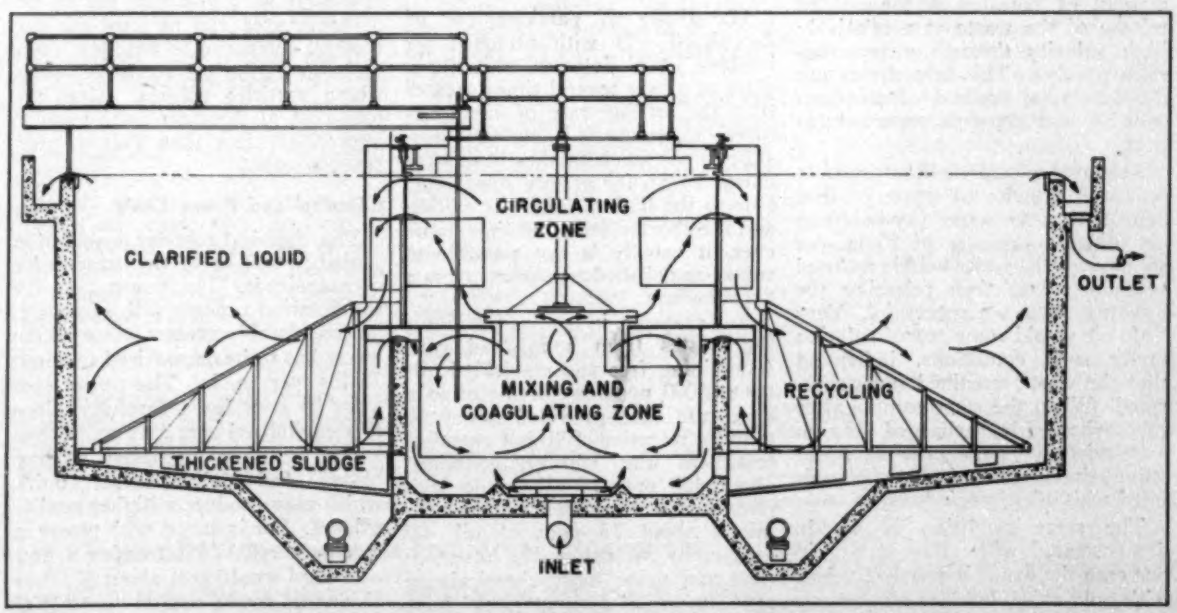

Fig. 1—SEDIMENTATION unit. The Infilco Cyclator for waste clarification and sludge thickening.

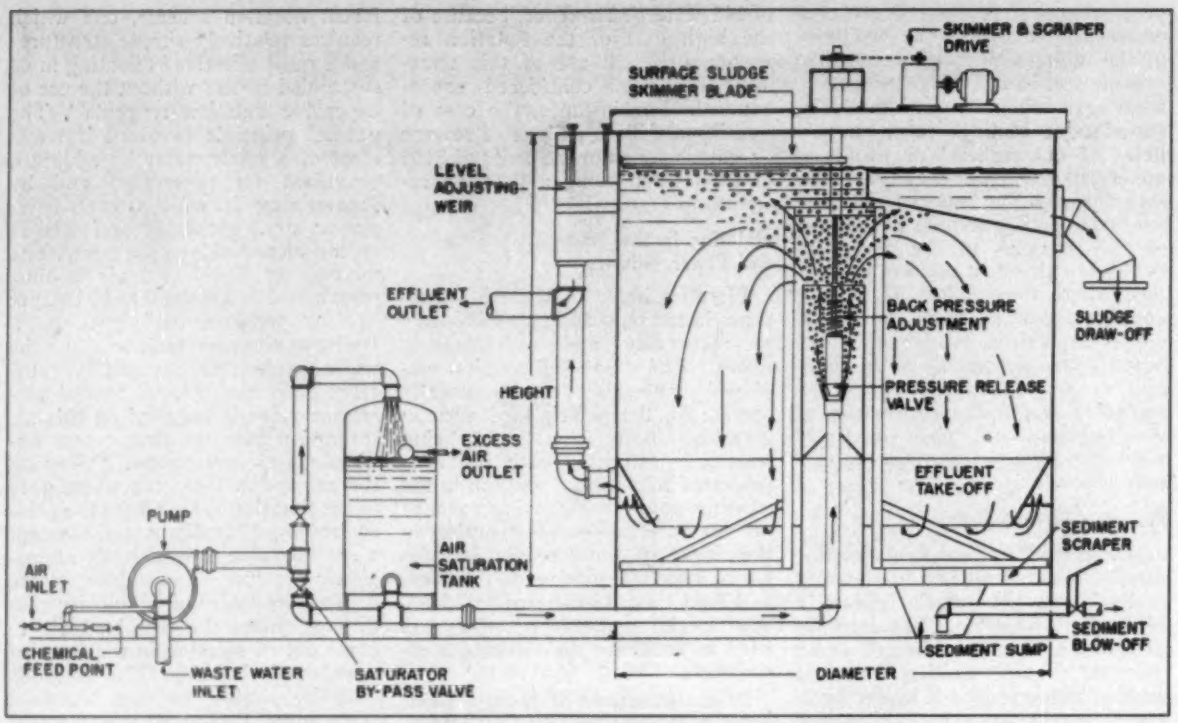

Fig. 2—FLOTATION unit. The Infilco Sediflotor for solids removal by a combination of flotation and settling.

some conditions this may increase suspended matter removals. Rohlich[8] has recently reported on a series of laboratory studies using a small pilot flotation unit, in which various schemes of recirculation and pressurization were employed when treating refinery wastes.

Continuous Flotation Studies

One important feature of this method of flotation is the sudden release of the waste at a relatively high velocity through a pressure-release valve. This step draws out the maximum amount of air from solution and prevents super-saturation.

Attempts to make laboratory tests on batch samples of waste by first pressurizing the waste (by bubbling air under a pressure of 25 lb. per sq. in., into the waste held in a closed container) and then releasing the pressure, were not successful. Very little air would come out of solution under such conditions, indicating that the waste remained super-saturated. When the same sample after pressurization is discharged through a restriction (such as a throttled valve) the discharged waste becomes filled with microscopic bubbles.

The same condition is readily demonstrated with clear water; in one case the water is relatively clear with only a few bubbles coming out of solution slowly, while in the second case, the water turns white. This indicates that laboratory tests on waste samples cannot be made properly on a batch basis, but rather should be treated on a continuous basis in an apparatus simulating the conditions of actual full-scale units. Flotation units for making small-scale tests of flotation treatment have been devised (Fig. 3).

Flotation Rates

The rising of particles (or of flocculated oil) with attached air bubbles in a flotation unit takes place at a rate several times greater than the settling rate of such particles. Therefore, it is generally possible to use much smaller basins for flotation than for gravity subsidence. Due to the higher velocities exiting and the shorter detention time, however, it usually is not possible to secure as polished an effluent from a flotation unit.

For example, in a pilot Sediflotor the wastes from a railroad yard (containing free and emulsified oils up to 5000 ppm) were treated at a flow rate that provided about 30 minutes retention. Without chemical treatment the effluent contained about 400 ppm of oil, while with chemical treatment the effluent contained about 75 ppm of oil. Of course, by increasing the retention time and using more chemicals an even lower oil content could have been obtained.

Settling and Flotation Compared

Since the *rising* rate of material, floated by use of flotation from a pressurized flow, is several times greater than the *settling* rate of similar material, it is always possible to use a relatively small basin size in the flotation process as compared to a basin where particles sink. Overflow rates of 2 to 4 gpm per sq. ft. of basin area can be used for the former, compared to overflow rates of ½ to 2 gpm per sq. ft. in basins where particles subside. Thus the first cost of flotation units may be appreciably less than that of subsidence units.

Chemical and Power Costs

The chemical cost for coagulation probably will be of the same order of magnitude. The power cost for the flotation process will, of course, be considerably greater, since all the waste has to be pressurized to about 25 lbs. per sq. in. The power cost must be considered carefully, since this capitalized cost may more than cover the cost of large settling basins and solids-contact units, which may produce a higher quality effluent. For instance, with power at 2 cents per K.W.H., treating a flow of 1 mgd would cost about $7.00 or an annual power cost of over $2500.

Treatment problems which should

not be handled in a flotation unit include those involving chemical precipitation where the chemical reactions are slow and where prolonged contact with previously precipitated solids is beneficial for complete reaction and absorption. It is not feasible to provide solids-contact in flotation units, and the retention times are much too short to make such contact worthwhile. Treatment problems of this type can best be handled in solids-contact clarifiers.

Sludge Thickening

A flotation unit will invariably produce a sludge considerably thicker than can be produced by gravity settling. In fact, the scum from the surface of a flotation unit frequently will be so thick as to be incapable of flowing. Flotation units of the type described can be used in many instances for thickening sludges from gravity settling units. For example, preliminary laboratory tests have indicated that a waste activated sludge which would not thicken any further by gravity settling in one hour, could be thickened to 50 per cent of its original volume by flotation in about 30 minutes.

Since units of both the solids contact type and flotation type have been used quite extensively for treatment of paper and board mill "white waters," a comparison might be made of the results obtained. Unfortunately, we do not have data where both schemes were used on the same waste. A Cyclator installation treating a board mill waste, which had a suspended solids content of about 600 ppm, produced an effluent having about 40 ppm suspended solids. An Accelator treating a tissue mill waste reduced the suspended solids from about 250 ppm to less than 10 ppm. At a paper mill, a flotation unit using alum and glue as coagulants, reduced suspended solids from about 500 ppm to 50 ppm. In general, white waters containing an appreciable amount of filter material, such as clay or calcium carbonate, should be treated in subsidence units if a high degree of solids removal is desired.

Conclusions

Whether any particular waste may be treated best by a simple gravity semdimentation unit, a solids-contact unit, or by a flotation process can be decided only after an impartial laboratory study is made. The laboratory study will provide data on the settling characteristics of the solids present or of the precipitates produced, and the efficiency of treatment possible with the various methods of handling the problem of solids-liquid separation. In some cases, pilot plant studies will be necessary. Only then can such items as first cost, operating cost, and efficiency of treatment be determined and evaluated. No one treatment method is superior to all others for solving all waste treatment problems.

The following generalizations can be made regarding the selection of settling or flotation methods for separating solids from liquids in the treatment of waste waters:

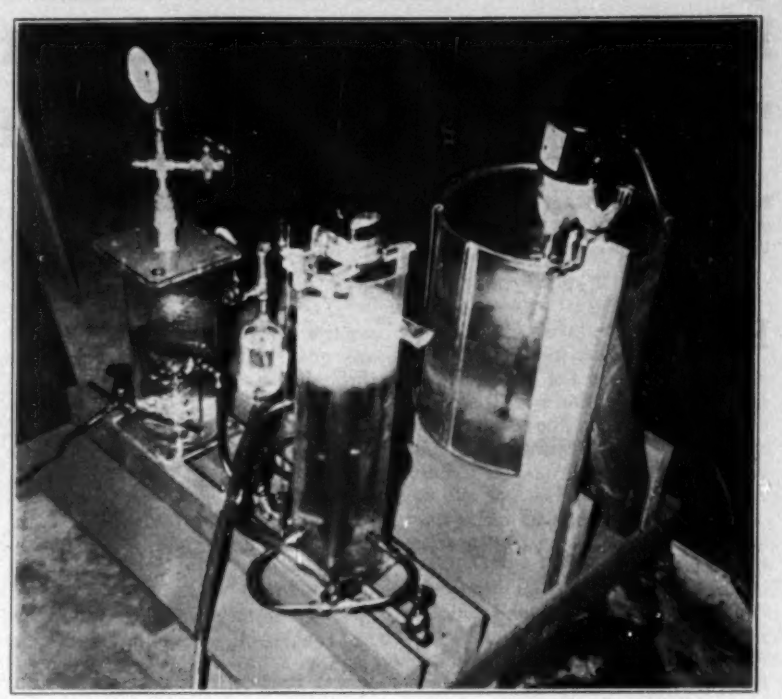

Fig. 3—PILOT unit. Small scale equipment for continuous flotation tests.

1. Flotation permits use of a smaller basin than does gravity settling.
2. In most cases a flotation unit will not produce as highly polished an effluent as will a gravity settling unit.
3. The operating costs will be considerably greater for a flotation process, primarily because of the higher power costs.
4. A thicker sludge can always be obtained from a flotation unit, than from a gravity settling.
5. Where completeness of chemical reaction, density of precipitates and absorption of material being coagulated is aided by prolonged slurry contact, a flotation unit should not be used; a solids-contact unit is indicated for such treatment problems.

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Signs of Water Progress For Street Excavations

In Brighton, England, so many people stop, stare and ask questions when workmen dig holes in streets that the water department has decided to put up notices on the spot giving full details of the operation. The department said notices will explain what is being done, why, how, and also the cost.

Improving Septic Tank Efficiency With a Gas-Deflection Baffle

by E. ROBERT BAUMANN, *Research Assoc. in Civil Eng.*
and HAROLD E. BABBITT, *Professor of Sanitary Eng.*
University of Illinois, Urbana, Ill.

RECENTLY an investigation of the operation of six small septic tanks was completed at the University of Illinois in cooperation with the Armco Steel Corporation. The results of this study have been published in a bulletin of the Engineering Experiment Station.*

The investigation was made using six steel septic tanks having capacities between 300 and 1800 gallons. Two of the tanks were of the usual cylindrical type, with baffled inlets and outlets; two were rectangular tanks, one with two and the other with three compartments; and two were small tanks using the Imhoff-tank principle.

The tanks were operated continuously in two series of tests over a period of more than two years. Raw domestic sewage from a Champaign-Urbana interceptor sewer was fed to the six tanks at the rates required to provide the same theoretical detention time in each tank.

The performances of the tanks have led to the conclusion that a septic tank provided with a simple gas-deflection baffle, installed at the outlet of the tank, will offer both the advantages of a standard septic tank and those of a tank having Imhoff-type baffles.

Standard Septic Tank in Operation

The details of a "standard," cylindrical septic tank having a capacity of about 500 gallons are shown in Fig. 1. Note particularly the manner in which baffles are placed. In normal operation, the incoming sewage is deflected downward by the influent baffle. This serves two purposes:

1. It prevents short circuiting of the sewage directly across the top of the tank, and
2. It mixes the incoming sewage with the more biologically active sewage and sludge in the tank.

The period of retention in the tank permits settleable solids to fall to the bottom, where they are reduced by anaerobic digestion. The gases which are given off during digestion rise through the sewage, carrying upward toward the surface numerous particles of digested, partially digested, and undigested sludge—together with their accompanying bacterial flora. Ths action serves to "seed" the sewage and improves the action of the tank in reducing the B.O.D., suspended solids, and the turbidity of the tank effluent.

When sewage enters a septic tank, an equal volume of liquid is discharged from the tank. The effluent baffle prevents scum which forms on the surface of the tank, from being carried into the effluent pipe. Since the contents of the tank are continuously disturbed by rising gases, some settleable solids always are carried off with the effluent when the tank discharges.

During the spring and fall seasons, septic tanks often are observed to "unload" a large amount of settleable solids; these are put into suspension in the tank by an overturning of the

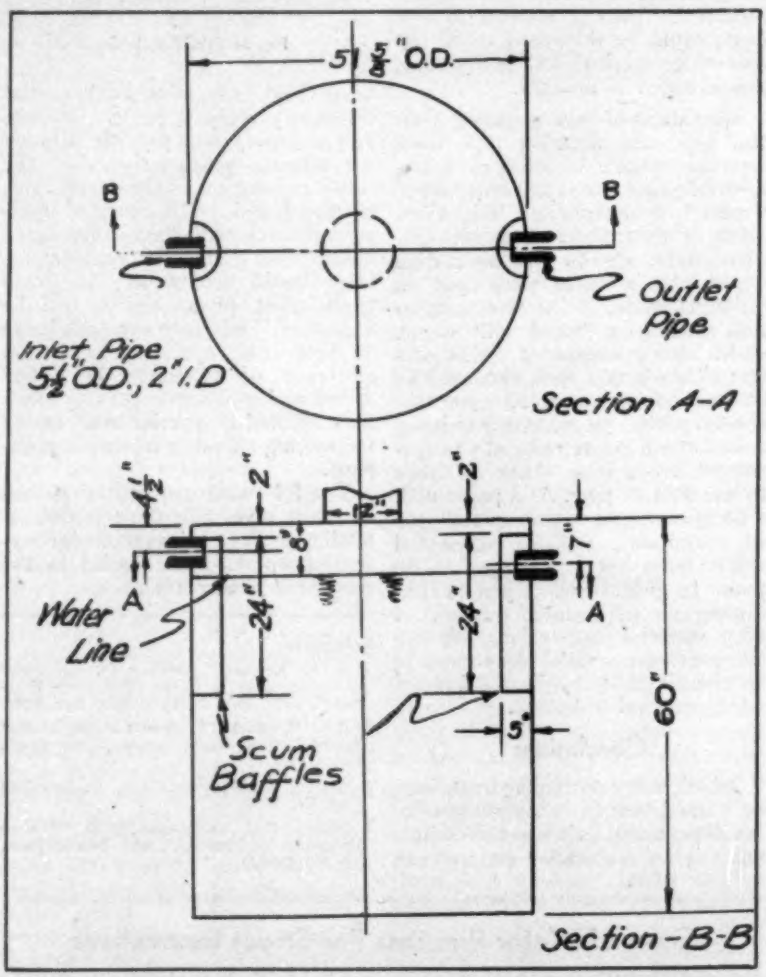


Fig. 1—STANDARD cylindrical septic tank. Nominal capacity is 490 gallons.

*Baumann, E. R. and H. E. Babbitt, "An Investigation of the Performance of Six Small Septic Tanks," University of Illinois Engineering Experiment Station, Bulletin Series No. 409, 1953.

tank contents. During septic tank unloading, the concentration of solids in the tank effluent may be many hundreds of times higher than the concentration of solids in the sewage normally entering the tank.

Public health authorities are interested in the operation of septic tanks, both to protect public health and to prevent stream pollution. The septic tank owner, on the other hand, generally is most interested in securing trouble-free operation; he has little concern regarding the effectiveness of his septic tank in treating sewage.

Normally, the trouble which most frequently plagues the septic tank owner is the backing up of sewage in the septic tank, a condition generally caused by clogging of the tile or underdrain field. In most cases, the clogging results from one or a combination of reasons: normal carryover of settleable and suspended solids from the tank, carryover of settleable and suspended solids from the tank during periods of unloading, and carryover of solids during periods of poor biological activity in the tank due to overloading.

Any device which might be added at small cost to a standard septic tank to prevent solids carryover would be of benefit both to the septic tank owner and to public health authorities. Such a device has been developed.

Proposed Revision of Septic Tank Design

A standard cylindrical septic tank equipped with a new type of gas-deflection baffle is shown in Fig. 2. The baffle is referred to as the Hamilton baffle, since the idea was suggested by R. E. Hamilton, Research Graduate Assistant at the University of Illinois.

In equipping a standard septic tank with the Hamilton baffle, two changes in tank construction are required:

1. The volume of sewage enclosed between the effluent scum baffle and the tank outer wall is increased to a minimum of about 12 to 15 gallons. (See location designated X in Fig. 2).
2. A gas-deflection baffle is installed below the scum baffle. It should prevent the gases rising from digesting material from entering the area inside the scum baffle. The gas-deflection baffle should be sloped sufficiently on its upper side to enable settling solids to fall to the lower part of the tank.

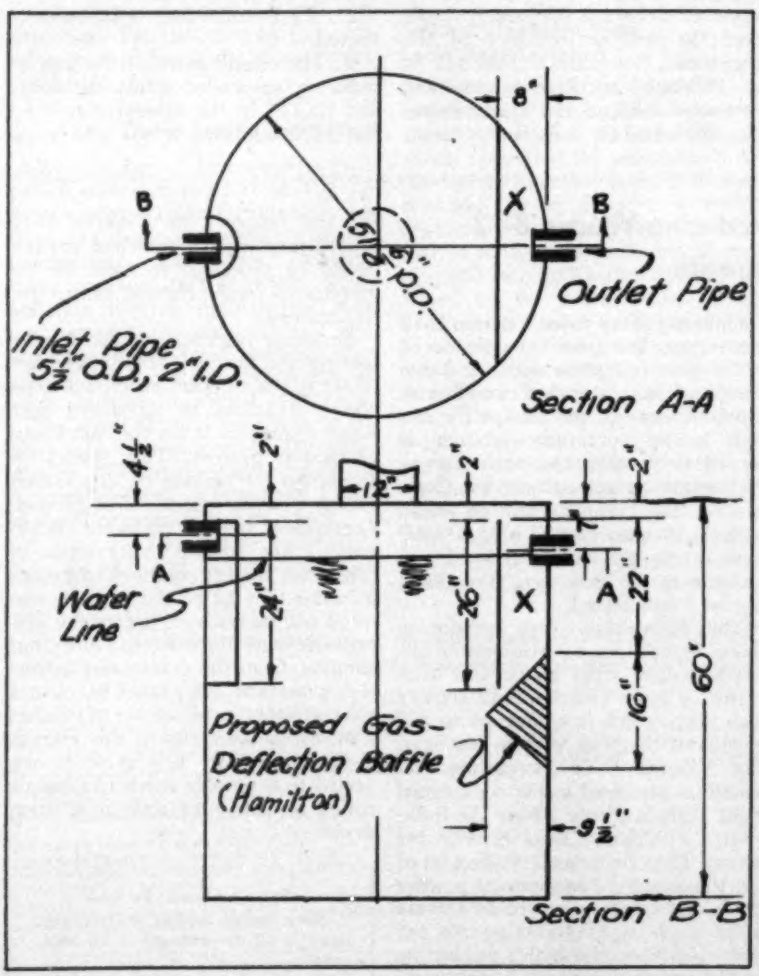


Fig. 2—PROPOSED gas-deflection baffle in standard cylindrical septic tank.

Overflow Protection

The minimum volume between the effluent scum baffle and the tank wall should be sufficiently large so that no settleable solids will be discharged from the tank. This volume should, therefore, be greater than the volume of any reasonable flow which may enter the tank as a "slug." A momentarily heavy flow from a single-family dwelling might result from the discharge of a water closet, a bath tub, or a laundry tray, and should not exceed 15 to 20 gallons. Hence, the minimum volume suggested for protection against gas disturbance (12 to 15 gallons) will function so that, in most cases, the sewage discharged from the tank will contain a minimum of settleable solids.

The Hamilton gas-deflection baffle will prevent rising gases from entering the area between the baffle and the tank wall. Some of the tank contents, carrying settable solids in suspension, will normally be carried into the protected volume each time sewage enters and is discharged from the tank. Since the discharge is not continuous and seldom will exceed 15 gallons at one time, the settleable solids carried into the protected volume will have time to settle out before that sewage is again discharged.

The baffle will at all times protect the volume of sewage behind the baffle from disturbance by rising gas bubbles.

A septic tank equipped with this Hamilton gas-deflection baffle may provide the following advantages over the standard tank:

1. Normal settleable solids in the tank effluent should be reduced appreciably,
2. Tank unloading should be prevented, and
3. The life of the underground tile field into which the effluent is discharged should be increased.

Type of Septic Tank and Treatment Efficiency

In order to evaluate the effect of Hamilton gas-deflection baffles on the performance of septic tanks, six small

septic tanks were operated at the University of Illinois. The following types of tanks were studied, each having a retention period of about 27 hours:

Tank No.	Capacity	Type
1	490 gallons	Standard cylindrical tank, baffled inlet and outlet.
2	750 gallons	Imhoff-type tank. Volume in a. Flow-through chamber = 17.6% of total b. Digestion chamber =32.4% of total c. Scum chamber =50.0% of total
3	500 gallons	Imhoff-type tank. Volume in a. Flow-through chamber = 22.5% of total b. Digesion chamber =20.5% of total c. Scum chamber =57.0% of total
4	810 gallons	One-compartment, rectangular tank with inlet and outlet baffles.
5	1080 gallons	Three-compartment rectangular tank, with gas-baffle protected outlet, scum baffle and no inlet baffle.
6	300 gallons	Standard cylindrical tank with inlet and outlet baffles.

Three of the tanks, numbers 2, 3, and 5, were equipped with gas-deflection or Hamilton baffles. Three of the tanks, numbers 1, 4, and 6 were equipped only with the usual scum baffle.

Operating Results

The tanks were operated in a similar manner for a period of six months, with the following results:

1. The Imhoff-type septic tanks and the tank equipped with the Hamilton gas-deflection baffle provided the best removal of settleable solids and suspended solids. The average settleable solids in the effluent from the six tanks were as follows:

Tank	Settleable solids ml/liter	% Reduction from raw sewage
1. Std. scum baffles	0.45	94
2. Hamilton & Imhoff	0.07	99
3. Hamilton & Imhoff	0.08	99
4. Std. scum baffles	0.83	90
5. Hamilton baffle	0.09	99
6. Std. scum baffles	1.79	78
(Raw sewage influent)	9.05	

The gas-protected effluents, therefore, contained about one-fifth the amount of settleable solids present in the effluent of the standard cylindrical tank, No. 1.

2. The ordinary septic tanks, utilizing disturbed digesting solids for seeding, provided the best reduction in the organic polluting load of the tank effluent as measured by the B.O.D. and turbidity.

3. The No. 5 tank equipped with the gas-deflection baffle (similar to that proposed for use on the standard cylindrical septic tank), provided a degree of treatment that nearly duplicated the best performance of the other tanks. For example, tank No. 5:

a. Produced an effluent containing settleable solids as low in concentration as that of the Imhoff-type tanks.

b. Produced an effluent whose suspended solids content and turbidity content were the lowest of all the tank effluents. This result indicated that the combination of seeding (with disturbed digesting solids) and the gas-trapped effluent chamber aided materially in reducing the organic polluting load of the effluent.

4. The Imhoff-type tanks and the gas-deflection-baffle equipped tank did not unload during the tests. The other tanks were observed to unload for periods varying from four days to two weeks.

Conclusions

Modification of the standard cylindrical septic tank, by the addititon of a simple Hamilton gas-deflection baffle at the outlet, may be expected to provide the following advantages over the standard tanks now in use:

1. The normal carryover of settleable solids in the effluent should be reduced to not more than one-fifth the amount in a similar tank not including the gas-deflection baffle.

2. Tank unloading will be prevented.

3. The effectiveness of the tank in reducing suspended solids, turbidity, and B.O.D. in the effluent should be increased slightly.

Pilot Plant in Operation Producing Vitamin B-12 from Milorganite

The Milwaukee Sewerage Commission and the Vern E. Alden Company, Engineers, Chicago, entered into an agreement last June to go into the vitamin business. The Chicago engineering firm has completed the construction of its pilot plant and is now continuously producing quantities of Vitamin B-12 concentrates. Pilot plant operations have included redrying of the Milorganite after the extraction operations. The Milorganite is reported to retain its value as a high grade fertilizer material.

The pilot plant operations have given very gratifying results confirming the suitability and validity of the patented process developed by the Commission's research consultants for extraction of the valuable vitamin concentrates from Milorganite. The pilot plant in the Chicago area has been erected and operated during the past six months to extract the Vitamin B-12 on a small scale at a cost of over $30,000. The Commission has already supplied the pilot plant with more than 60 tons of Milorganite for these processing tests.

Sufficient spray-dried Vitamin B-12 concentrate has now been produced at the pilot test plant and the Alden Company has furnished samples to potential users. If the market for this high quality premium product is proved to be adequate, according to the contract agreement with the Commission, the Company will go ahead with the construction of a $1,000,000 plant for the production of B-12 concentrate at the Sewerage Treatment site on Jones Island.

The Milwaukee plant, producing about 70,000 tons of Milorganite annually, could yield about 140 kilograms of pure Vitamin B-12 activity each year, which is equivalent to 308 pounds of the pure vitamin per year. The Vitamin B-12 concentrate that would be produced in the commercial plant contains only about 20 milligrams of Vitamin B-12 activity per pound. Thus the annual production of the Vitamin B-12 concentrate powder in the commercial plant could amount to as much as 7,000,000 pounds per year. However, the entire production of Milorganite might not be processed for the recovery of Vitamin B-12 concentrate: only a sufficient amount would be processed to meet the requirements of the current market for this material.

Conveyor belts are planned for detouring the finished Milorganite fertilizer to the adjacent extraction plant where it would be moistened with water to prepare it for the continuous extraction process. This process is similar to the making of drip coffee, except that the spent coffee grounds (equivalent to the extracted Milorganite) are washed many times by constantly weaker solutions of extract in order that all of the valuable material will be removed before the Milorganite would be redried. The extract solution from the continuous extraction process is evaporated in vacuum concentrators, using steam to produce a molasses-like syrup of the Vitamin B-12 concentrate. This syrup is converted to a powder much like instant coffee or powdered milk in a spray dryer.

Know Anybody Like This?

Some people are like blotters; they soak it all in—*but*, get it all backwards.

REPORT FROM ABROAD

The Detergent Situation

With comment on a new sewage treatment works and a new report on water and sewage

by JOHN FINCH, *Manager, Sewage Disposal Department*
Rotherham, England

A COMMITTEE on Synthetic Detergents has been set up by the Ministry of Housing and Local Government, under the Chairmanship of Sir Harry Jephcott, chairman and managing director of the Glaxo Laboratories. The influence of this committee will be felt in the sewage treatment field.

Synthetic Detergents Committee

Membership of the committee comprises representatives from the detergent manufacturing industry; detergents-using industries; various government departments including those covering public health, water pollution research, and fisheries; various non-technical officials; and last, but by no means least, one lone sewage treatment officer in the person of C. B. Townend of West Middlesex!

The work of the Committee, as indicated by the make-up of the membership, will be all-embracing in its ramifications and will conform to the terms of organization which are:

"*. . . . . To examine and report on the effects of the increasing use of synthetic detergents and to make any recommendations that may seem desirable with particular reference to the functioning of the public health services . . . . .*"

Sewage Treatment Field Lacks Representation

The make-up of the Committee has come in for a fair amount of criticism since its inception, and the Ministry which appointed the members of the Committee has come in for even more criticism. It is thought in certain quarters of the sewage treatment field that, as most other public health services will be directly or indirectly affected by the reactions of sewage treatment processes to the general use of detergents, far greater representation from the sewage treatment field should have been made by the Ministry. This is not an unreasonable point of view, and it may be that other sewage treatment technicians will be appointed to the Committee in the course of time.

In the meantime, the Committee has circularized a selected list of sewage treatment authorities and, through the medium of a questionnaire, has cross-examined them on the matter of detergents and detergent treatment at the sewage plant. Each authority has been asked to supply to the Committee with a complete story in facts and figures of its sewage treatment activities beginning in 1948, the year in which the observations of the effects of detergents on sewage treatment processes first were noticed. Many authorities have records of the rise in detergent concentration in the raw sewage from 1948 onwards; when correlated with other data of plant performance, these data may lead to important and far-reaching conclusions.

Detergent Concentration Data

Strangely enough—and this applies in the U. S. as well as in Great Britain—very little is heard about actual detergent concentrations in raw sewage, settled sewage, etc. References of a qualitative nature are legion but references of a quantitative nature very rare indeed. Whether this is due

Table 1

RESULTS OF ANALYSIS OF SAMPLES TAKEN AT PERIODS OF ONE HOUR 9 A.M. TO 9 P.M. 10/6/53.
Romanby-Brompton Sewage Works, Northallerton R.D.C.

	Raw Sewage	Raw Dairy Effluent	Settled Sewage	Settled Dairy Effluent	Primary Filter Influent	Primary Filter Effluent	Primary Clarifier Effluent	Secondary Filter Influent	Secondary Filter Effluent	Secondary Clarifier Effluent
	Parts per Million Except pH Value									
Solids in suspension (dried at 105°C.)	114	560	65	107	91	.....	.....	.....	.....	.....
" " " ash	22	.....	12	18	14	.....	.....	.....	.....	.....
Chlorides (in terms of sodium chloride)	145	185	135	140	150	145	145	145	145	145
Ammonia-nitrogen, from free & saline ammonia	.....	.....	.....	.....	20.0	.....	.....	.....	.....	1.1
Albuminoid nitrogen (Wanklyn)	.....	.....	.....	.....	7.0	.....	.....	.....	.....	0.7
Nitric nitrogen from nitrates	.....	.....	.....	.....	NIL	0.5	0.6	NIL	2.9	3.8
Oxygen absorbed in 4 hours from N/80 permanganate at 80°F. (Total)	29.5	250	22.0	127	60.0	10.0	9.6	11.6	10.2	6.0
Oxygen absorbed in 4 hours from N/80 permanganate at 80°F. (Filtrate)	15.0	194	13.5	121	45.0	.....	.....	.....	.....	.....
Dissolved oxygen absorbed in 5 days at 65°F.	163	1180	.....	.....	257	.....	.....	.....	.....	8.4
pH value	6.9	4.1	6.9	5.7	6.4	7.0	7.0	7.1	6.9	7.0

Analysis carried out by the Chief Inspector's Dept. of the Yorkshire Ouse River Board.

to lack of faith in the analytical methods or to other reasons is debatable, but what is quite certain is the dearth of analytical data.

However, it would appear that in some of the industrial areas of Great Britain, where grime is Public Enemy No. 1, and the combatting of the enemy in the home is a full time job, detergents are being strongly exploited by the manufacturers. The domestic uses can be referred to as very fertile ground; in some instances the concentration of detergent in the raw sewage, expressed in terms of Teepol (sodium alkyl sulphate) which contains some 20 percent of active material, has risen from zero before 1948 to 50 ppm in 1953! In these instances, the per capita flow of sewage is of the order of 25-30 gal. per day, the B.O.D. of the raw sewage being about 500 ppm, constituting a "strong" sewage in every sense of the word.

Photo by Dr. F. W. Mohlman

DETERGENT FROTHING at the Mogden activated sludge plant in England

Mr. Clarence Lumb, of the Halifax Sewage Department, one of the workers who first brought the detergent problem to prominent notice (and in many quarters considered an unfortunate omission from the Detergents Committee) has recently published experimental data on the effects of certain synthetic detergents on the biological oxidation of sewage. His contribution is confined to a particular phase of the subject on which available knowledge is scanty, and refers to the effects of small concentrations of certain detergents on the purification of settled sewage by the percolating filter and by the activated sludge process.

In his conclusions, Lumb states that his results indicate the efficiency of these processes is adversely influenced by small concentrations of detergents of the alkyl-aryl-sulphonate and non-ionic types. The inhibitory effects of mixtures of the two detergents corresponds to the sum of the effect of detergents ascertained singly. Increased treatment plant capacity could largely offset the effects of moderate concentrations (in the case of percolating filters), but not that of high concentrations (in the case of activated sludge). The activated sludge process was found to be permanently *inactivated* to some extent by the alkyl-aryl-sulphonate. The deterioration of treatment efficiency caused by these detergents becomes significant when their concentration reaches about 10 ppm in settled sewage and increases sharply above this level. This concentration in settled sewage corresponds to approximately 20 ppm total concentration of all detergents in raw sewage; concentrations of this order are imminent in many cases, and would be widespread with the envisaged material increase in detergent consumption.

It is rather interesting to note that the two types of detergent used in Mr. Lumb's investigations do not exhibit a B.O.D. value, but do show an oxygen absorbed value (acid permanganate text). In Great Britain, of course, the B.O.D. test is not as highly regarded as a measure of load on a sewage treatment plant, as is the case in the United States; but is considered more useful as an indication of the character of the effluent from the sewage treatment plant.

Particularly is this the case in certain industrial areas where the B.O.D. value of a raw sewage may be quite low but the oxygen absorbed value quite high; these characteristics constitute a strong sewage difficult to treat, the B.O.D. figure being quite misleading as a basis of strength or load. Mr. Lumb has accordingly included the oxygen absorbed value due to the detergent as part of the load on his experimental plant.

Alternating-Double Filtration Plant at Northallerton

A new sewage treatment plant has recently started operation in the Brompton and Romanby districts of the old town of Northallerton in North Yorkshire, and the opportunity was afforded to interested sewage treatment plants operating and design personnel to inspect the plant.

Much interest was shown in the installation primarily because it involves an alternating-double-filtration scheme in a district in which there is no other similar type of plant, and because it handles a milk waste in addition to the normal domestic sewage load.

The old village of Romanby with its village green, separated from the town of Northallerton by the railway at the turn of this century, was sewered some fifty years ago, the sewage being conveyed to a piece of land adjoining the River Wiske. After World War I, what was originally a loading dock for the milk collected in this essentially dairying area, was developed into dried milk factory. It is not surprising therefore that land disposal proved totally incapable of giving any practical treatment to the sewage-milk waste mixture, and that conditions in the little River Wiske became very bad. At Brompton, sewage was treated in septic tanks and the effluent was discharged directly into the stream.

Secondary Treatment Plant for Two Communities

Subsequent to World War II, sewage treatment works were designed to treat sewage from the two drainage areas, the method of treatment selected being separate preliminary treatment for the milk waste and alternating - double - filtration of the mixed milk waste and settled domestic sewage.

The design was based on the treatment of the sewage from a population of 2,400 persons and an ultimate population of 3,750; also included was the 30,000 gal. per day of milk wastes; and the mixed wastes were diluted with about 53,000 gal. per

day of infiltration water. In all, approximately 175,000 gal. per day will be received for treatment at the sewage plant.

The completed plant consists of three horizontal flow (manually desludged) primary settling tanks having a total capacity of 94,500 gal., or approx. 15.5 hours detention at dry weather flow; two fill-and-draw settling tanks for the milk wastes having a capacity of 25,000 gallons (tanks to be used alternately). The two percolating filters contain 2,735 cubic yards of material, equivalent to applying 65 gal. per cubic yard per day per filter on the ultimate flow basis, or 130 gal, with alternations. There are two primary humus tanks, manually desludged, having a capacity of 30,000 gal., providing about four hours detention at ultimate flow, and two secondary humus tanks of similar size.

Analyses of the sewage and the various effluents are available. It is very apparent that the sewage is extremely weak, especially for British sewage. The sewage and milk wastes do not together provide anything like a full load for this little plant.

New Report on Water and Sewage

A report on "Water Supply and Sewage Disposal" was recently published by the Organization for European Economic Co-operation and is based on the work of the Technical Assistance Mission which visited the United States. The report has been received in this country with very great interest, by those people who were sufficiently fortunate to happen upon the information that such a report existed, and has caused quite a bit of cogitation and chin-scratching.

The fact that our own Col. F. G. Hill, the Adviser on Sewerage and Sewage Disposal to the Ministry of Housing and Local Government, was chairman of the body of experts which dealt with the sewage treatment angle, and that Dr. Arthur Key of the same Ministry was another member of the panel, must of course add color to some of the observations made by the panel, especially so far as British readers are concerned.

The cogitation and chin-scratching factor is introduced because of the fact that any local authority in England wishing to go forward with a sewage treatment scheme must of necessity proceed to the Ministry of Housing & Local Government for approval of that scheme. In consequence, any indication of the direction of a trend coming from a body of experts including gentlemen of the calibre of the two in question, occasions the very greatest deliberation on the part of a would-be designer of a new scheme.

It is a very great pity that this report has not received considerably more publicity in view of one or two very contentious observations contained in it. Possibly the one that will cause the most disturbance is that which reads:

". . . . . in view of the undoubted success achieved by surface aeration in activated sludge plants . . . . . we are drawn to the conclusion that the value of fine bubble diffusion . . . . . has been much overstressed. In support of this conclusion mention may be made of the good results achieved with diffuser pipes pierced with ¼-in. holes, and with some jet aerators elsewhere . . . . ."

There are many considered statements in the report, which runs to 150 pages, but to my mind this is the most outstanding. It also is one that may eventually have the greatest influence on a process of treatment which has been literally suffering from suffocation for some considerable time as a result of the antics of the conventional diffusers.

This matter will be discussed in more detail in the next installment.

Use of Plastic Pipe Expanding at Rapid Pace

A predicted sales volume for 1953, amounting to $20,000,000 compares with but $500,000 in 1948.

The manufacture of pipe from plastics is expanding rapidly into a really important industry.

The use of plastic pipe was a warborne development, when plastics were used as a substitute for hard to get metallic pipes. With this beginning the production and use of plastic pipe and tubing has been one of the most spectacular post-war developments.

Just recently a cross-country oil line of 3 inch plastic pipe operating under 90 psi pressure was completed. This first experimental line is 9 miles long and such use of plastic pipe is expected to prove the solution of the costly corrosion problem of cross-country oil and gas lines. It is its resistance to corrosion, its flexibility, and its light weight that makes plastic pipe of marked interest, even though at this stage of production the pipe costs about twice as much as steel pipe of like diameter. An offsetting advantage is the fact that because of its smooth surfaces, a plastic line is reported to have a capacity 30% greater than steel pipe of like diameter.

The chief weakness of plastic pipe to date is its inability to withstand more than moderate pressures. The plastic pipe producers, fully cognizant of this weakness, are searching for methods of reinforcing plastics with some fibrous materials such as glass fibers, nylon, etc.

Farmers have been among the largest users of plastic pipe for water lines. Other important uses have been as well casings and as drainage lines for oil field brines and acid mine waters. In the water works field it is being used experimentally as customer service lines.

Plastics used in pipe production are made by large chemical companies. The most popular plastic has been the polyethylene plastics produced by the Dupont Co. and Union Carbon & Carbide Corp. Polyvinyl Chloride and Tenite is produced by Tenn. Eastman Co., a division of Eastman Kodak Co.

Of interest is the fact that some steel pipe producers are now experimenting with plastic pipe production and the production of plastic jacketed steel pipe.

"C'MON UP BILL, WE SHOULD A BROUGHT A WRENCH IN THE FIRST PLACE."

Let's Push Sewage Research

An Open Letter from One Sewage Works Man to Another

Dear Bill:

A few months ago, in *Water & Sewage Works*, I read a letter to you from "Ed" on the subject of "Research and Experimentation in Water Works Problems." Now I know that you are also superintendent of sewage treatment as well as of your water works, and I'd like to put in my two cents worth about sewage research—or, rather, the lack of it.

You know the Sewage Works Federation is promoting a research program. I understand that Executive Secretary Wisely has been authorized to employ a new assistant who will take over administrative detail, thus permitting Mr. Wisely time to promote and direct Federation activities along research lines.

On this subject of research I like to remember Charles Kettering's remark, " 'Research' is a high-hat word that scares a lot of people. It needn't. It is rather simple. Essentially it is nothing but a state of mind—a friendly, welcoming attitude toward change. Going out to look for change instead of waiting for it to come. Research for practical men is an effort to do things better and not to be caught asleep at the switch . . . . . "

Something You and I Can Do

There are, as you well know, two kinds of research: fundamental and practical. Basic (fundamental) research is something the universities and governmental agencies must carry on; you and I don't have the facilities, the time or the funds. However, when it comes to practical research (or as Kettering said, "The effort to do a thing better") that is something you and I can do. In the realm of practical research there are two roads to follow. Both lead to practical and useful results. The first of these is "plant studies" and the second "laboratory investigations." In your city, with good laboratory facilities and several chemists you can follow both paths, but in my smaller plant with limited staff I'll stick to plant studies, although I am going to think and talk to others about laboratory experimentation whenever I can.

In the realm of plant studies even the collection of good operating records leads to improved operation and any work expended to collect data on sewage strength, characteristics, or idiosyncrasy of treatment is practical research in essence, for it may lead to "doing things better."

For Example

Records collected on power costs for pumping versus the solid's concentration of sewage sludge may indicate that it is worthwhile to seek a means of concentrating the sludge to reduce its water content. I know a fellow who made chlorine demand studies of his sewage throughout the day and was able to develop a dosage chart that saved him nearly 20 per cent on his city's chlorine bill. He is the same fellow who made a study of industrial wastes and developed a rate formula for charging industries for treatment of concentrations above normal. The returns almost paid for the yearly cost of operating his routine laboratory.

In the small plant, analysis of sludge coupled with a sales promotion campaign may help dispose of the sludge at reduced cost if not actually at a profit. In plants practicing mechanical sludge dewatering, studies to determine proper dosages of conditioning chemicals will often save far more than the cost of the chemist who makes the study. Where sewage is pumped, studies of flow, both dry weather and storm flow, may indicate pumping programs that would save power costs.

I read somewhere that Milwaukee was developing vitamin B-12 from activated sludge. That's fine, but we all know that any formula of sludge contains many trace elements that should be returned to the soil. What we need is some research on how to get these trace elements back where they came from, without costing a small fortune.

In the field of laboratory studies to which universities, large plant laboratories like yours and maybe even my small one can contribute, are improvements in laboratory tests such as settleable solids, volatile matter, volatile acids, chemical oxygen demand and improvements in sampling techniques.

Some Questions Needing Answers

Other questions that come to mind are:

1. Can treated sewage effluents be safely used for recharging dwindling ground water supplies?
2. Can sedimentation tank design be improved to increase suspended solid removal above the maximums now obtained?
3. Can flocculation by air be used to increase removal of suspended solids in subsequent sedimentation and at the same time reduce the B.O.D.?
4. Can the use of tonnage oxygen for biological oxidation compete with other secondary treatment processes?
5. Does chemical treatment with flocculation offer a future for competition with partial secondary treatment?
6. Can activated silica be used to aid flocculation and improve sedimentation?
7. Is the use of water softening sludge for sewage treatment feasible?
8. Can upflow clarifiers be developed to eliminate problems of septic sludge?
9. Can controlled sludge digestion using special strains of bacteria be developed to reduce digestion time and produce certain desired by-products?
10. Can the gases now produced in sludge digestion be used as the raw materials for creating synthetic chemical compounds?
11. Are enzymes and enzymatic substances capable of producing better and faster reactions and beneficial effects in sewage works?

Speaking of research, I remember a Purdue professor who said that, "Research is making intelligent mistakes and profiting by them." But as Kettering once said, "Unintelligent motion is far more important than intelligent standing still." And I remember hearing an editor, talking before a section of a sewage treatment association, who said, "It isn't only the immediate result of your work that pays off, but there are other dividends such as: Respect and gratitude of the profession, increased professional standing for the plant and the personnel, better operation, lower costs and improved public relations."

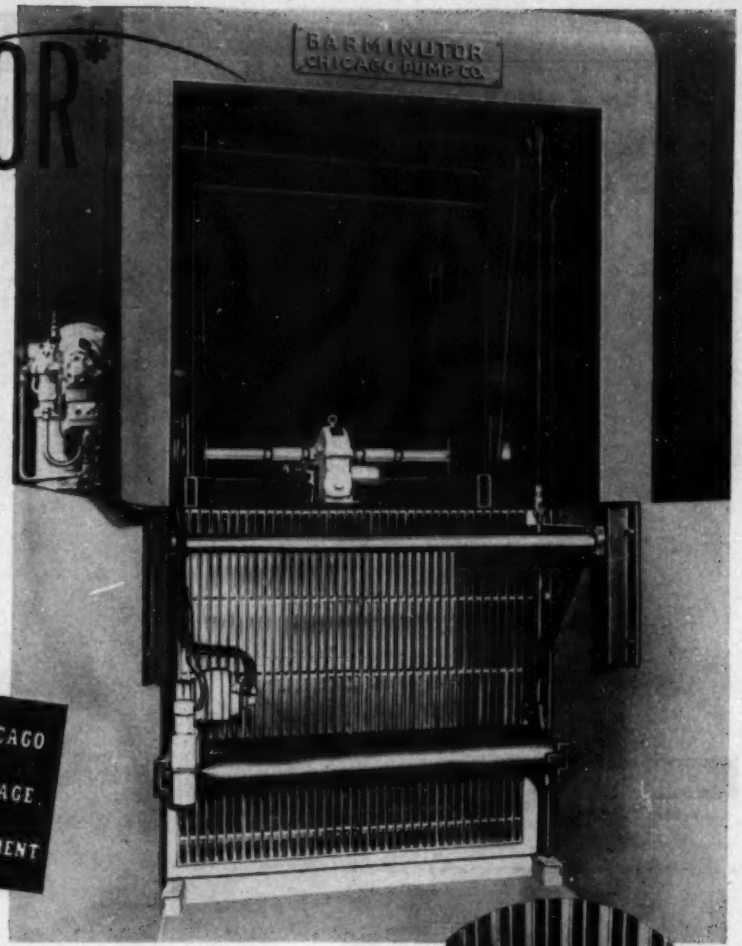
By the way "Bill," if you by any chance have been thinking along these same lines, regarding unsolved problems requiring study, I am sure H. W. Wisely, Exec. Secy. of the Federation of Sewage and Industrial Water Assns., Champaign, Ill., would like to hear from you. Tell him what you think the problem is and the basic questions to be answered—and, for what it's worth, I am sending him a copy of this letter with my ideas.

Yours,

Russ

BARMINUTOR*

A New Comminution Development



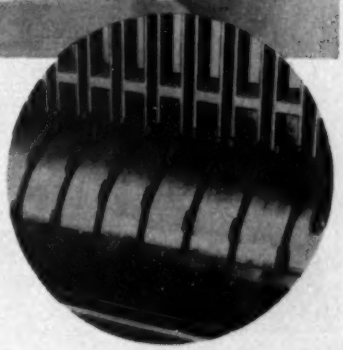
Barminutor installed in 5' channel.

The Barminutor Model "A" exclusively provides the advantages of comminution with maximum economy for flows from 10 to 15 M.G.D. Screening and cutting of coarse sewage material is accomplished without removal from the flow, maintaining continuous cleaning of the screen. The Barminutor, developed and tested over five years, based on fifteen years successful experience with the Comminutor, eliminates odors and handling nuisance in the screening process. High rate cutting in the flow—comminution—provides low maintenance cost and long life for cutting parts.

In tests conducted on a Barminutor installed at the Indianapolis, Indiana Sewage Treatment Plant, the unit was subjected to test loads of screenings up to six times normal load for 40 M.G.D. This material was comminuted and the screen completely cleaned in six minutes. Even with this heavy load head loss through the screen did not exceed 6". Like the Comminutor, power requirements are low.

FUNCTION OF THE BARMINUTOR

1. Cleaning the ¾" vertical bar screen and cutting of the screenings is accomplished by continual travel of the comminuting unit at 8 ft. per minute. Both upward and downward travel is controlled by an electric reversing brake motor.
2. The cutters on the comminuting unit, rotating at 400 R.P.M., travel within slots of the U-shaped bars and carry coarse material to the combs for cutting.
3. The direction of rotation automatically reverses when the direction of travel changes. The combs automatically position themselves to accomplish rapid cutting for each direction of rotation.
4. Uncuttable material is automatically rejected without damage to the cutting parts.
5. Rotation of cutters, position of combs and rejection of uncuttable material is accomplished through oil powered hydraulic system.



Close-up of Cutters and Combs. Cutters rotate within slots of Bar and Comb.

*Chicago Pump Company's trade name for its new screening and comminuting device for large sewage flows from 10 M.G.D.

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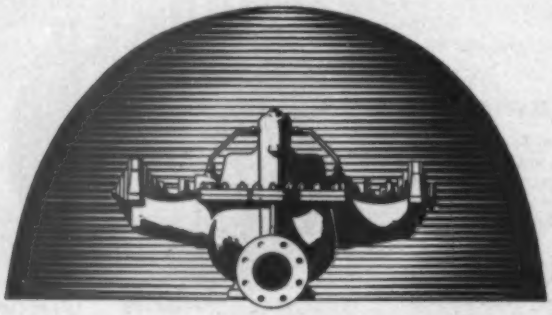

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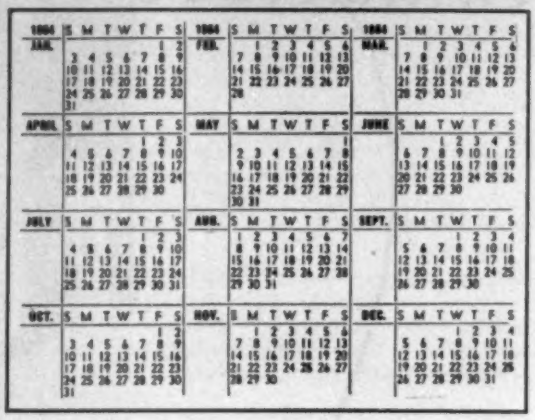
Meetings Scheduled



Mar. 10-12—Atlantic City, N.J. *(Traymore Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION, Sec'y, Michael S. Kachorsky, P.O. Box 766, Manville, N.J.

Mar. 10-12—Baton Rouge, La. *(Louisiana State Univ.)*
WATER & SEWERAGE SHORT COURSE. Director, John H. O'Neill, Dept. of Health, New Orleans, La.

Mar. 17-19—Chicago, Ill. *(LaSalle Hotel)*
ILLINOIS SECTION A.W.W.A. Sec'y, Dewey W. Johnson, 122 So. Michigan Ave., Chicago, Ill.

Mar. 18—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND SECTION A.W.W.A. Sec'y, Geo. G. Bogren, 14 Beacon St., Boston 8, Mass.

Mar. 18—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Mar. 18-19—Raleigh, N.C. *(North Carolina State College)*
THIRD SOUTHERN MUNICIPAL & INDUSTRIAL WASTE CONFERENCE. Conference Chairman, Dr. Nelson L. Nemerow, Dept. of Sanitary Engineering, N. C. State College, Raleigh, N.C.

Mar. 22-24—Little Rock, Ark. *(Marion Hotel)*
ARKANSAS WATER & SEWAGE CONFERENCE. Sec'y, Dr. Harrison Hale, Southern State College, Magnolia, Ark.

Mar. 22-26—Amherst, Mass. *(New England Field Training Center)*
SEWAGE TREATMENT WORKS OPERATORS SHORT COURSE. Director, A. A. Robertson, State Dept. of Health, Boston, Mass.

Mar. 29-31—Greenville, S.C. *(Poinsett Hotel)*
SOUTHEASTERN SECTION A.W.W.A. (25th Annual Meeting). Sec'y, N. M. deJarnette, 245 State Office Bldg., Atlanta 3, Ga.

Apr. 7-9—Emporia, Kan. *(Broadview Hotel)*
KANSAS SEWAGE WORKS ASSOCIATION. Sec'y, Dwight F. Metzler, State Board of Health, Marvin Hall, Room 2, Univ. of Kansas, Lawrence, Kan.

Apr. 7-9—Emporia, Kan. *(Broadviwe Hotel)*
KANSAS SECTION A.W.W.A. Sec'y, Harry W. Badley, 119 West Cloud, Salina, Kan.

Apr. 12-14—Toronto, Ont. *(Royal York Hotel)*
CANADIAN SECTION A.W.W.A. Sec'y, A. E. Berry, Ontario Dept. of Health, Toronto, Ont.

Apr. 14—Norway, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Apr. 22—New York, N.Y. *(Manhattan College)*
CONFERENCE ON INSTRUMENTATION IN WATER, SEWAGE & INDUSTRIAL WASTE TREATMENT. Director, Brother Joseph McCabe, Civil Engineering Dept., Manhattan College, New York 71, N.Y.

Apr. 22-23—Watertown, N.Y. *(Woodruff Hotel)*
NEW YORK SECTION A.W.W.A. (Annual Spring Meeting. Registration evening of 21st). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

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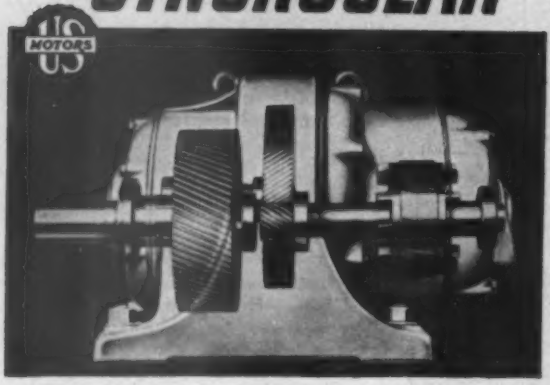

The motor that internally gears its speed

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Apr. 22-23—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, University of Nebraska, Lincoln, Neb.

Apr. 22-24—Tucson, Ariz. *(Santa Rita Hotel)*
ARIZONA SECTION A.W.W.A. Sec'y, M. V. Ellis, Supervisor Sewage Treatment Plant, Phoenix, Ariz.

Apr. 22-24—Tucson, Ariz. *(Santa Rita Hotel)*
ARIZONA SEWAGE & WATER WORKS ASSOCIATION. Sec'y, M. V. Ellis, 46 Encanto Blvd., Phoenix, Arizona.

Apr. 22—Bozeman, Mont. *(Hotel Baxter)*
MONTANA SEWAGE & INDUSTRIAL WASTES ASSOCIATION, Sec'y, Harry W. Taylor, Morrison & Maierle, Inc., Helena, Mont.

Apr. 23-24—Bozeman, Mont. *(Baxter Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Board of Health, Helena, Mont.

Apr. 22-23—Boston, Mass. *(Hotel Somerset)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, State Dept. of Health, Providence, R.I.

Apr. 29-30—Frederick, Md. *(Hotel Francis Scott Key)*
MARYLAND-DELAWARE WATER & SEWAGE ASSOCIATION. Sec'y, W. M. Bingley, 2411 N. Charles St., Baltimore 18, Md.

May 4-6—Chicago, Ill. *(Hotel Morrison)*
AMERICAN PUBLIC POWER ASSOCIATION. Exec. Sec'y, Alex Radin, 1757 K St. N.W., Washington, D.C.

May 5-8—Sacramento, Calif. *(Hotel Senator)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sam A. Weed, Room 315, City Hall, Oakland, Calif.

May 10-12—Lafayette, Ind. *(Purdue University)*
NINTH PURDUE INDUSTRIAL WASTE CONFERENCE. Director, Prof. Don E. Bloodgood, Purdue University, Lafayette, Ind.

May 20-21—Staunton, Va. *(Hotel Stonewall Jackson)*
VIRGINIA INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, J. L. Hamrick, Jr., 415 W. Franklin St., Richmond, Va.

May 23-28—Seattle, Wash. *(Exhibits and Technical Sessions—Auditorium)*
AMERICAN WATER WORKS ASSOCIATION. (74th Annual Convention). Exec. Sec'y, Harry E. Jordan, 521 Fifth Ave., New York 17, N.Y.
(For hotel accommodations apply to A.W.W.A. headquarters office.)

June 7-11—Columbia, Mo. *(University of Missouri)*
MISSOURI WATER WORKS SHORT COURSE. Director, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

June 9—Lubec, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

June 14-15—Syracuse, N.Y. *(Hotel Syracuse)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Executive Committee Dinner Sunday Evening, June 13.) Sec'y, R. C. Sweeney, State Dept. of Health, White Plains, N.Y.

June 14-18—Chicago, Ill.
AMERICAN SOCIETY FOR TESTING MATERIALS. Sec'y, Raymond E. Hess, 1916 Race St., Philadelphia 3, Pa.

June 14-19—Atlantic City, N.J. *(Chalfonte Haddon Hall)*
AMERICAN SOCIETY CIVIL ENGINEERS. Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

June 23-25—Allentown, Pa. *(Americus Hotel)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

June 22—Boonton, N.J. *(The Knolls Golf Club)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N.J.

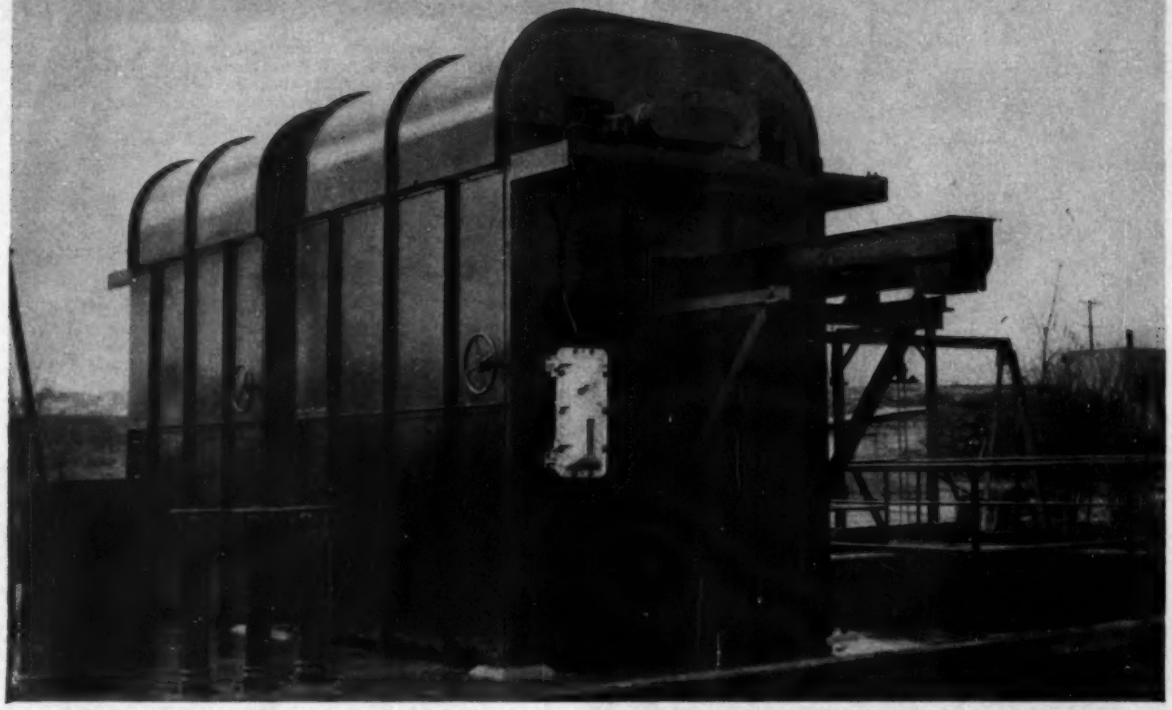
June 24-26—Richmond, Ind. *(Hotel Leland)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, A. Paul Troemper, 2029 Bates Avenue, Springfield, Ill.

July 25-31—Sao Paulo, Brazil *(Univ. of Sao Paulo)*
INTER-AMERICAN CONFERENCE SANITARY ENGINEERING. Write to General Secretariat, Fourth Inter-American Conference San. Eng., Caixa Postal 8099, Sao Paulo, Brazil.

Aug. 11—Bingham, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

(Continued on page 82A)

WALKER PROCESS DETENTION TYPE BASINS WITH SELF-ELEVATING GRIT COLLECTOR



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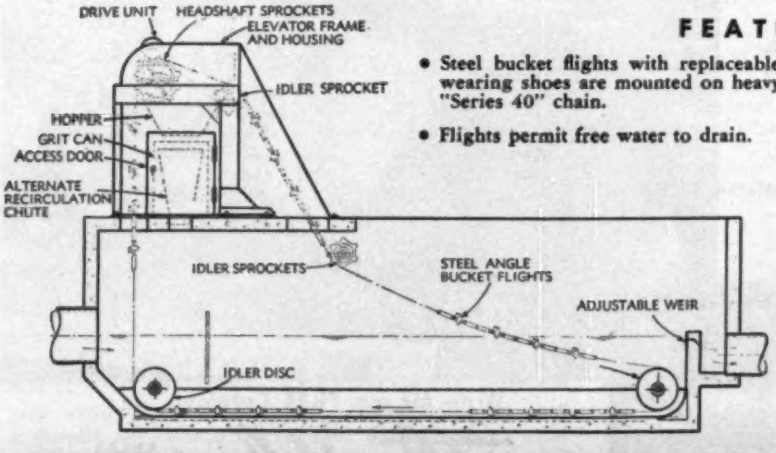
The grit collecting-elevating mechanism shown below is well adapted for situations where construction space is limited, fine grit is present and where the collected grit must be elevated to a considerable height.

The V-buckets are specially designed for high capacity loads to reduce operating time and wear. Collected grit may be discharged to containers, or to cross conveyors for removal to trucks or receiving bins.



FEATURES

- Steel bucket flights with replaceable wearing shoes are mounted on heavy "Series 40" chain.
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- Scraping action of the flights frees organic matter which is then washed out of the tank.
- Grit recirculation (adjustable) gives absolute control over putrescible content.

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(*Continued from page 80A*)

Aug. 23-25—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. R. Kountz, Pennsylvania State College, State College, Pa.

Aug. 25-27—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 9-10—Montauk, N.Y. *(Hotel not selected)*
NEW YORK SECTION A.W.W.A. (Annual Fall Meeting). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Sept. 15-17—Muskegon, Mich. *(Occidental Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 420 6th Ave. N., Nashville, Tenn.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, R. Paul Farrell, 420 6th Ave. N., Nashville 3, Tenn.

Sept. 22-24—Dayton, Ohio *(Biltmore Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 22-24—Regina, Sask. *(Saskatchewan Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 26-28—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 28-30—Green Bay, Wis. *(Northland Hotel)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Oct. 4-6—Poland Spring, Me. *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION. (73rd Annual Convention). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

(*Continued on page 86A*)

Another TYPICAL TOWN
SAVING MONEY WITH "Flexibles"

Keene, New Hampshire, population 15,638, is another of many typical American towns that employ "Flexible" sewer-cleaning equipment. It originally purchased two "Flexible" Power Bucket Machines early in 1952. That the machines are put to good use and serve a real need is evidenced by this recent photograph showing a storm drain being cleaned . . . the pile of dirt representing a partial "haul" from one manhole. City officials primarily responsible for choosing "Flexibles," after careful comparison, are Fred E. Whitney, Superintendent of Public Works, and Earl Davis, Chairman, Public Works Committee. They recommend "Flexibles" highly.

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to

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of new sewerage and drainage lines*

Lewis Goodell, City Engineer, and Jones, Henry & Schoonmaker, Consulting Engineers, had their eyes on *future,* as well as present costs when they designed new interceptor sewers for Lorain . . . Here's how their call for TYLOX-jointed, REXON-coated concrete pipe helped Lorain citizens get *more* for their waste disposal money . . .

FAST-WORKING TYLOX helped offset high construction costs with *more pipe down per day* . . . sped the project even further by eliminating "wet trench" delays . . . permitting *immediate* backfilling.

LEAK-PROOF TYLOX solved infiltration problems with *compression-tight joints* . . . helping to keep loads down at the treatment plant . . . assuring sediment-proof and root-proof pipe connections.

CORROSION-PROOF TYLOX provided joints that would last . . . *never shrink or deteriorate* . . . And the acid-proof, abrasion-resistant REXON coating inside the pipe was an *extra* safety factor . . . equipping the lines to handle any unusually corrosive wastes which might be required of them in the future.

Write for complete information and case histories on TYLOX RUBBER JOINTS and REXON Pipe Coating. See how these corrosion-prevention products assure taxpayers of "most for their money" on big *or* little sewerage and drainage jobs. And plan now to specify TYLOX Joints and REXON Coating on *your* next pipe project.

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13,048 ft. of Interceptor Sewers.

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ENGINEERS:
Lewis Goddell, Lorain City Engineer, and Jones, Henry & Schoonmaker, Consulting Engineers, Toledo, Ohio.

CONTRACTOR:
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Water Rates in Wisconsin

Where the Public Service Commission must approve all publically owned utility rates

Representative rates for water service in the State of Wisconsin may prove of particular interest to readers of *Water & Sewage Works*, because in Wisconsin all rate structures of publically as well as privately owned utilities must have the approval of the State Public Service Commission. The following are representative rates for cities of 20,000 to 100,000 population:

City (Pop. 20- to 100-Thousand)	Quarterly Bill—2500 cu. ft. or less
Oshkosh	$3.25
La Crosse	3.28
Kenosha	3.30
Eau Claire	3.41
Madison	3.50
Janesville	3.60
West Allis	3.63
Manitowoc	3.71
Sheboygan	3.82
Wauwautosa	4.13
Appleton	4.30
Racine	4.40
Green Bay	4.40
Waukesha	4.89
Wausau	5.10
Fond du Lac	6.25
*Beloit	6.45
*Superior	6.80

*Privately owned systems

By contrast the rates go down with the size of the city. Milwaukee, for instance, has a quarterly rate of only $2.44 for the permissible use of 2500 cu. ft. in the 90 day billing periods. In practically all cases rates are set to provide a net profit, over and above all costs and charges, amounting to approximately 5% on the worth of the system. Also, for the most part the water utility operates as an independent agency under a Water Board or Commission.

Statistical Summary Published Covers U.S. Water Supply and Treatment Practices

A "Statistical Summary of Water Supply and Treatment Practices in the United States" has recently been published by the U.S. Dept. of Health, Education and Welfare, Public Health Service.

This report summarizes and discusses data on public water supply and

treatment facilities, based on the 1948 Inventory of Water and Sewage Facilities (unpublished). Part I, Basic Data, presents 28 pages of extensive basic data in tabular form.

Part II, Analysis and Discussion, provides tabular information relating to water supplies, treatment plants, and unit facilities (disinfection, softening, aeration, taste and odor control, and corrosion control).

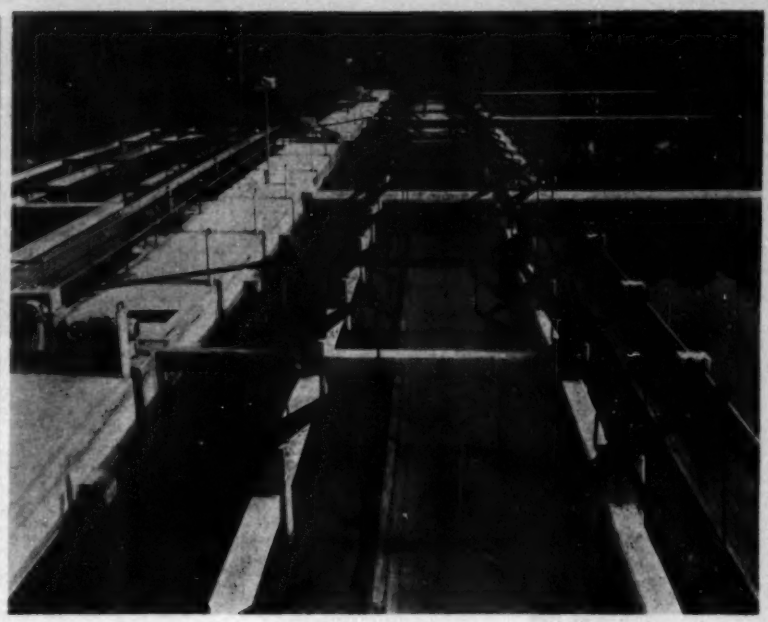
Copies of the summary (Public Health Service Publication No. 301) may be purchased from the Supt. of Documents, U.S. Govt. Printing Office, Washington 25, D.C., for 20 cents. It is recommended as the latest and most comprehensive reference material.

Utility Can Be Required To Extend Services

According to a report in the Newark, N.J. *Evening News*, a public utility company may be ordered to extend its services to an area, even though the extension does not show a profit, so long as the over-all return on the company's operation is fair and reasonable, the New Jersey Appellate Division ruled on February 4, 1954.

The decision was in an appeal by the Township of Lakewood against a decision by the Public Utilities Commission in favor of the Lakewood Water Co. The utility has the sole water and sewage disposal franchise for the township.

The decision was based on a statute which enables the PUC to order a utility to extend its facilities where: 1. the extension is reasonable and practicable, 2. will furnish sufficient business to justify the construction and maintenance of the same and 3. when the financial condition of the public utility reasonably warrants the original expenditure required in making and operating the extension.



6 Reasons why

WALKING BEAM FLOCULATION

is now specified by water works engineers

1. **Eliminates troublesome underwater bearings.**
2. **Eliminates expensive dry well construction.**
3. **All bearings accessible for inspection and lubrication.**
4. **Produces quick responsive floc formation.**
5. **Longer filter runs.**
6. **A saving in alum.**

Write today for Bulletin 451 and a list of water purification plants that have gone modern.

STUART CORPORATION
516 N. CHARLES ST., BALTIMORE 1, MD.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

(*Continued from page* 82A)

Oct. 4-6—Atlantic City, N.J. *(Chalfonte-Haddon Hall)*
PENNSYLVANIA MUNICIPAL AUTHORITIES ASSOCIATION. Sec'y, Claude C. Fogelman, 1717 Main St., Northampton, Pa.

Oct. 11-14—Cincinnati, O. *(Netherland Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

(In conjunction with)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conard, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N.Y. *(Statler Hotel—*Tech. Sessions, *Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting). Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 18-22—New York, N.Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

Oct. 19-22—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, David Dunlap, 504 N. Second St., Harrisburg, Pa.

R. D. Wood Gate Valves are reliable because they are uncomplicated

Available with mechanical joint connections.

There's a sort of reverse English to designing R. D. Wood Gate Valves. The point is to make them as simple as possible, to eliminate all the ingeniously complicated parts that look good in the blueprint but cause operating failures deep down in the lines. You'll appreciate their rugged simplicity when you put them to the test. R. D. Wood Gate Valves are built to function for generations of trouble-free flow control.

FEATURES OF THE R. D. WOOD GATE VALVE

Internal mechanism comprises only three parts—the spreader and two discs. Usual small wedges and delicate parts are avoided. Fully opened valve provides unobstructed passage for full pipe capacity.

Rising or descending, discs are free to revolve completely. In closing, discs are fully lowered before spreading action begins. Wear on bronze faces of discs and seats is evenly distributed.

R. D. WOOD COMPANY

Public Ledger Building
Independence Square, Phila. 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

R. W. Hooker Reelected President of Chlorine Institute

R. W. Hooker, vice president of Hooker Electrochemical Co., Niagara Falls, N.Y., was reelected to his sixth consecutive term as president of The Chlorine Institute Inc. at its annual meeting in New York. Louis Neuberg, vice president of Westvaco Chlor-alkali Division of Food Machinery and Chemical Corp., was reelected vice president. Robert T. Baldwin was reelected secretary-treasurer.

Mr. Hooker has been associated with the chlorine industry since he joined Hooker in 1922 and is active in many industry and civic affairs.

D. B. Stokes Dies

United States Pipe and Foundry Company, Birmingham, Alabama, has announced that D. Birney Stokes died at his home in Edgewater Park, New Jersey on January 17, 1954. He retired as vice president in charge of sales for the Company in 1952 after serving in that capacity since 1926. Mr. Stokes had been associated with U. S. Pipe since 1910. He was an active member of A. S. A. Sectional Committee (A21) on Specifications for Cast Iron Pipe and Special Castings whose work resulted in ten modern specifications for these products.

(*Continued on page* 88A)

For value in full measure

Value is measured not only in quality and uniformity but in service as well. You get full value in all three when you use Nialk chemicals.

for instance...

NIALK LIQUID CHLORINE: Always uniform in quality, NIALK Liquid Chlorine, when added to circulating cooling water in condensers and low-temperature heat exchangers, keeps under control the organic slimes which normally form on tube surfaces and seriously impair efficiency.

The value to industry of this and other NIALK products is created not only through constant research and strict quality control but also through fast, safe delivery and close attention to industry's needs.

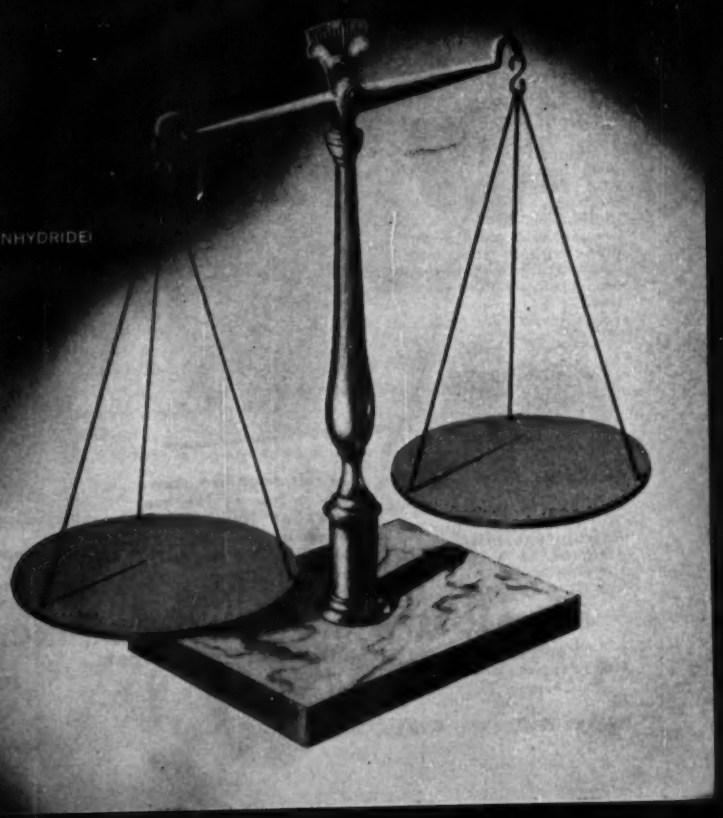
NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, New York

Nialk®

LIQUID CHLORINE
CAUSTIC POTASH
CARBONATE OF POTASH
PARADICHLOROBENZENE
CAUSTIC SODA
TRICHLORethylene

NIAGATHAL (TETRACHLORO PHTHALIC ANHYDRIDE)



(*Continued from page 86A*)

He was also an active and long-time member of the American Water Works Association and the American Gas Association.

Fume Hood with Remote Controls

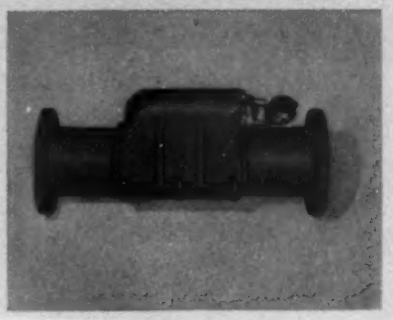
301

Fisher Scientific Co., Pittsburgh, Pa., has developed a fume hood with extended controls that is now available as a standard unit of the Fisher line of "unitized" laboratory furniture.

By means of the Extended-Control Fume Hood any normal hood service can be started and stopped, and its rate adjusted without opening the window.

Should the laboratorian desire to slow the heating rate of a burner in a potentially dangerous reaction, or protect a delicate reaction from drafts, he leaves the protecting safety-glass window down, turns the gas control knob from the outside.

No longer, too, need he insert his head and shoulders into a hood filled with toxic or hazardous fumes—he controls the water rate (or air or vacuum or gas) with a single twist of the wrist on the front panel.



New Irrigation and Line Meters

302

Hersey Manufacturing Co., South Boston, Mass., has developed the Hersey Models MV and MH irrigation and line meters. Essentially similar in design, the model MV is intended for vertical installation to measure water flowing under low head to open distribution ditches. The model MH is designed for measuring water pumped from wells or flowing through pipes under pressure.

The meter is of the proportional type, impeller-driven, and consists of a main line section and a by-pass section, the latter containing the registering mechanism which is of the impeller type. The main line section consists of a waterway with suitable pipeline connections. It is provided with an internal orifice section of slightly less diameter so located as to cause a percentage of the flow to be shunted through the registering unit. The registering unit is set by means of change gears to indicate the full amount flowing through the meter.

Among the characteristics of the meters are simplicity of design, accessibility of parts for inspection or service, large bearings, small, rugged impeller, interchangeability of parts among different sizes, and low cost.

Wallace & Tiernan—Novadel Agene Merge

Wallace & Tiernan Co., Belleville, N.J., has announced that a merger of the associated companies, Wallace and Tiernan Co. Inc. and Novadel-Agene Corporation, into a single oragnization known as Wallace & Tiernan Incorporated has been completed.

The new company's principal lines of activity include: Wallace & Tiernan chlorinators, water purification apparatus, chemical feeders and materials handling equipment, processes for treating fresh produce, electrical specialties, lighthouse equipment, precision pressure sensitive instruments and ethical pharmaceuticals; Novadel

(*Continued on page 90A*)

Pipe Line Equipment
WATER • GAS • SEWER

Bottled Gas Lead Melting Furnace

Asbestos Joint Runners

Best quality asbestos rope, brass caps attached to each end. Equipped with clamps.

M-D Cut-In Connections for Sewers

A light cast iron fitting with bell end for connecting house service with main sewer pipe without necessity for placing a Y-branch or T-branch in the sewer line.

Leak Detector

A truly fine instrument designed to solve even the most difficult leak detecting problem.

Caulking Tool Outfit

For water mains up to 12". Strong leather bag. Keeps the right tool for every job within easy reach.

Test Plugs for Bell or Spigot End Cast Iron Pipe.

On this page are shown only a few of the hundreds of items to be found in the POLLARD Catalog. Write for a copy of Catalog No. 25G.

Portable Lead Melting Furnace

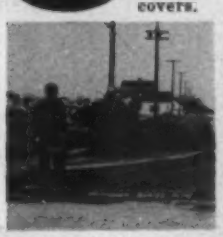
A handy outfit for quick action, equipped with gasoline burner.

Pipe Cutter

Inexpensive way of cutting pipe. Every wheel in contact with the pipe is a cutting disc, so cutter need be moved only a short distance to cut entirely around the pipe.

Tapax

The original manhole cushion. Takes the bang out of manhole covers.



M-Scope Pipe Finder

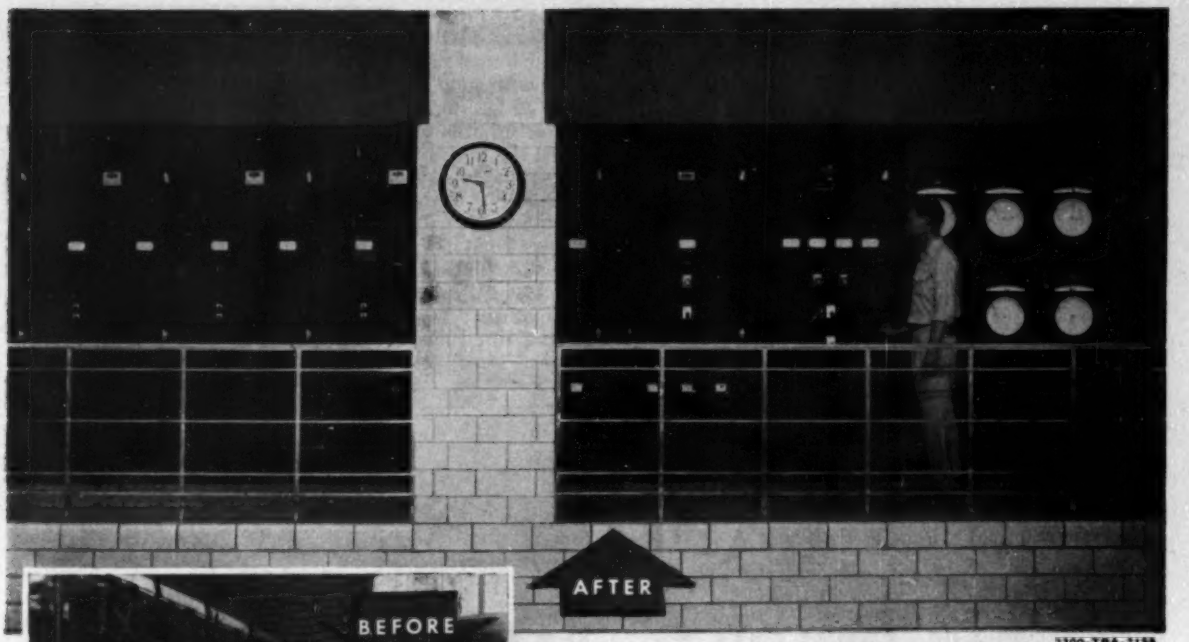
It's easy to locate a buried pipe line with this handy pipe finder.

JOSEPH G. POLLARD CO., INC.

Western Office
1064 Peoples Gas Bldg.
Chicago, Ill.

MAIN OFFICE AND FACTORY
New Hyde Park, N. Y.

Southern Office
333 Candler Bldg.
Atlanta, Ga.



"X" MARKS THE OLD CONTROL HAZARDS THAT WERE eliminated at Council Bluffs: 1. Inadequate protection to electrical equipment. 2. Exposed disconnects. 3. Exposed wiring, unenclosed sides and rear. 4. Manual operation, subject to human fallibility. 5. Old style meters, too high and hard to read. All of these were *eliminated entirely* by the modern E-M HI-FUSE Control installation described at right.

3300-TPA-2158

Are there control hazards in your plant?

These are the questions which should be checked on regularly:

How *safe* is the motor control system in your plant? How *reliable?* How *effective* in handling short circuits? How *capable* of meeting increased load requirements?

E-M engineers have made a specialty of solving problems such as these. For example, the E-M Magnetic HI-FUSE (High-Voltage, High-Interrupting Capacity) Control will give your plant a completely modern method of motor operation and protection. Shown above is a typical HI-FUSE Motor Control which replaced the old equipment at left in the Council Bluffs, Iowa Waterworks.

And this is how HI-FUSE eliminated the hazards marked "X" in the old picture:

1. HI-FUSE *current-limiting* power fuses provide *short-circuit* protection to motor, control and power system.
2. HI-FUSE has enclosed fuse disconnects, fully protected.
3. Nothing "hangs out" . . . no danger to unauthorized personnel with HI-FUSE modern enclosed cabinet design.
4. HI-FUSE operation is "push button" magnetic . . . accurate, convenient, reliable.
5. Modern HI-FUSE meters are placed at eye level, can be read quickly and easily.

Installed in single units or in group line-up, E-M HI-FUSE Controls are pre-engineered, economical "packages" with a clean, sharp appearance. You can select oil switches or air-break contactors, as HI-FUSE offers both.

To see how this reliable control system will work in your plant, contact your nearest E-M sales engineer. Also, write for new *E-M Synchronizer No. 39*, "ABC of Large Motor Control".

Specialists in making controls do

EXACTLY WHAT YOU WANT THEM TO

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

(Continued from page 88A)
organic peroxides and equipment processes for treating flour; Richmond sifters and separating equipment; Hardesty fatty acids and plasticizers; Thomson bakery equipment; and Electro Rust-Proofing cathodic protection services.

Atlas Mineral Forms New Division

Atlas Mineral Products Company, Mertztown, Pa., announces the formation of its Thermoplastic Structures Division as part of its program of expansion in the extrusion of pipe and the fabrication of plastic structures.

The Thermoplastic Structures Division now offers a complete line of pipe in sizes up to 6" O.D. with molded fittings for pipe up to 2" O.D. Standard ductwork is available in sizes up to 40" I.D.

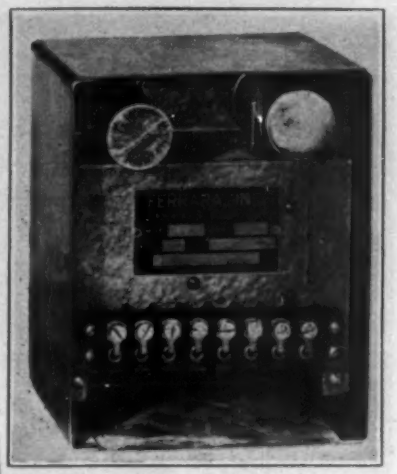
This Division has established fabrication shops and sales outlets in the following cities: Boston, Mass.; Cincinnati, Ohio; Cleveland, Ohio; Detroit, Michigan; Houston, Texas; Johnson City, Tenn.; Los Angeles, Calif.; Milwaukee, Wisconsin; Passaic, New Jersey; Peoria, Ill.; Philadelphia, Pa.; St. Louis, Mo.; and Waterbury, Conn.

Electric motor operation is recommended for large M & H Gate Valves, or where valves are frequently operated, or where valves are located in remote, inaccessible or hazardous places. The remote control, possible with electric motor operated M & H Valves, is a convenience which frequently increases efficiency and reduces operating costs.

The 36" motor operated M & H Valve illustrated here is standard M & H Gate Valve design and construction—iron body, bronze mounted, double disc, parallel seat. All sizes of electric motor operated M & H Gate Valves are available in Class A for 50 lbs. working pressure, Class B for 100 lbs. working pressure or A.W.W.A. Class C for 150 lbs. working pressure. Furnished with hub, flanged or mechanical joint ends.

M & H Gate Valves may be ordered equipped also with usual accessories such as gearing, by-passes; rollers, tracks and scrapers; double square bottom, indicators, or for hydraulic cylinder operation. For complete information, write or wire M & H Valve and Fittings Company, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION



New Liquid Level Controls

303

Ferrara Inc., Oak Park, Michigan, has developed two new Floatless Liquid Level Controls with sensitivity, accuracy and performance unaffected by temperature, pressure, acids or salts, and provide positive hair-line control for liquids of low and high conductivity, at any distance.

The controls are available in two basic types, electro-magnetic and electronic. The electro-magnetic unit features a unique circuit employing a DC operated relay for hum and chatter free operation, with AC in the probe circuit.

The electronic unit with less than two microamps current in the probe circuit employs a cold cathode amplifier for use with liquids having resistivities up to 200 megohms.

Both units can be used as high or low level cut-off, alarm or differential control. Probes of many materials, shapes and sizes are available.

P. S. Wilson Appointed Representative of Welsbach

The Welsbach Corporation, Philadelphia, Pennsylvania, has announced that it will be represented in the New York and New Jersey area by P. S. Wilson, of Glen Ridge, New Jersey, in the sale of the Kitson Division Water Works Brass Goods

(Continued on page 92A)

"We use American Meters because of their simple design and quick servicing . . . fewer men handle the work."

"It costs money to keep a crew of meter repairmen. That's why we selected the water meters that were simplest in design and easiest to service . . .
AMERICAN METERS.

Even when AMERICAN METERS are frozen, we find no damage to anything but the frost bottom. All internal parts, including the gear train, have separated, avoiding ice damage. Breaking pressure of the replacement frost bottoms has been predetermined at the factory, so we don't need torque wrenches on the nuts. Yes, when we think of economy in water meters, we think of AMERICAN METERS."

• Write for complete information . . . today.

BUFFALO METER CO.

2909 Main Street, Buffalo 14, N. Y.

(*Continued from page* 90A)

and Corporation Tapping Machines.

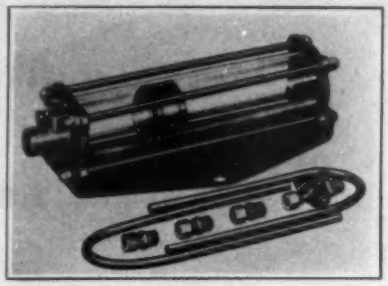
Mr. Wilson's territory will consist of the eastern part of New York State, northern New Jersey and a portion of Connecticut. The WELSBACH-Kitson Line will be in addition to the other companies whom he has been representing up to the present.

Pipe Linings, Inc. Buys Bechtel Somastic Division

The Bechtel Corporation, San Francisco and Pipe Linings, Inc., Los Angeles, Calif., announce the sale of the SOMASTIC Division of Bechtel Corporation to Pipe Linings, Inc. Pipe Linings, Inc. is a wholly owned subsidiary of the American Pipe and Construction Co.

All operations conducted in 11 western states and all foreign countries will now be handled by Pipe Linings, Inc. The transfer includes all patent rights and licenses to the SOMASTIC Pipe Coating process for the exterior treatment of steel pipe as protection against corrosion, material manufacturing and application plants currently in operation on the West Coast, and all personnel of the SOMASTIC Division.

Mr. J. S. Connell, general manager of the SOMASTIC Division, Bechtel Corporation, will remain in an advisory capacity for a period of time. Mr. Austin S. Joy, general sales manager will move over to Pipe Linings, Inc. as sales manager of that organization.

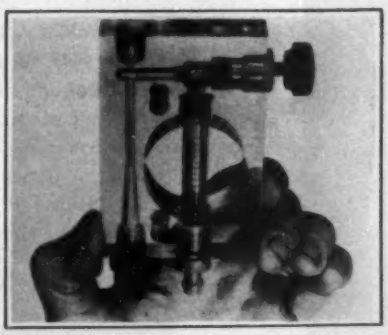


New Grease Seal for Centrifugal Pumps

304

Zimmer & Francescon, Moline, Illinois has developed a new grease seal for centrifugal pumps. The unit consists of an air tight glass cylinder with plunger. Two copper tubes with fixtures, attach the unit to pump casing and packing gland housing. The unit is easy to install on any centrifugal pump with no loss of operating time.

Once installed, the Z-F Grease Seal automatically supplies the shaft packing gland with grease under pressure. According to the company this unit has proved its effectiveness in the prevention of excessive heat—rapid wear—leakage—and scoring of the impeller shaft at the point it enters the pump casing.

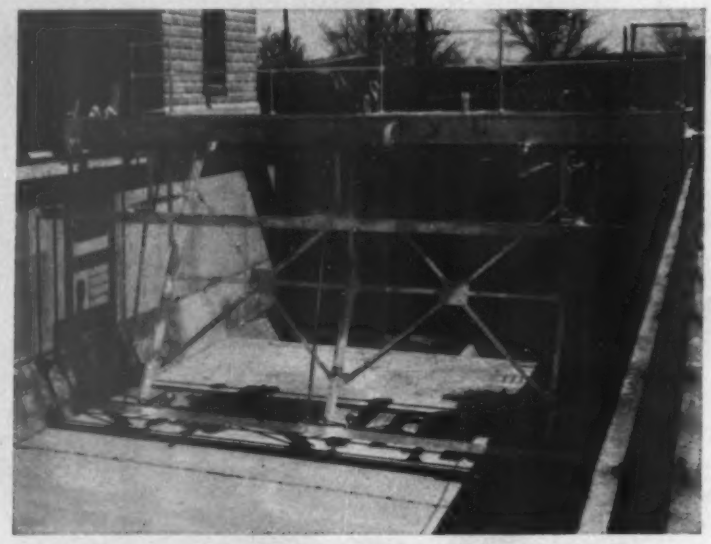


Compact Chemical Feeder Meter Controls and Mixes Corrosive Liquid Chemicals

305

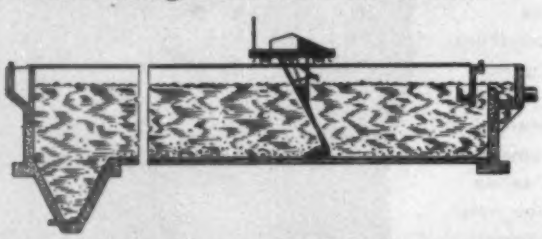
Fischer & Porter Co., Hatboro, Penna., has developed a rugged, compact chemical feeder for simultaneously metering, controlling, mixing and dispensing small porportions of liquid chemicals into liquid streams.

(*Continued on page* 94A)



HARDINGE RECTANGULAR CLARIFIERS

for Sewage and Trade Wastes



Particularly suitable where space is limited or where sludge delivery is desired at one end of tank. Consists of a bridge crane spanning width of the tank supporting sludge scraper and skimmer, which moves automatically back and forth.

Many of these units are now operating in sewage plants throughout the country. This unit has also proven highly successful as an oil-water separator in the treatment of oil refinery waste water. Also used in other industrial waste applications. Bulletin 31-D-15.

HARDINGE

COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

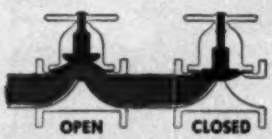
What valve would you specify?

It takes a versatile valve to "fill the bill" in water, sewage and industrial treatment plants. Grinnell has this valve. It's the famous Grinnell-Saunders Diaphragm Valve.

This unique Grinnell valve, though employing only a single basic design, provides a wide choice of body, lining and diaphragm materials.

For example, on lines handling filter alum, either glass or rubber lined Grinnell-Saunders Valves, equipped with neoprene diaphragms, may be had. For sodium silicate, an iron bodied valve, with neoprene diaphragm, is recommended.

Yes, the amazing adaptability of the Grinnell-Saunders Diaphragm Valve in handling highly corrosive fluids, gases, compressed air, beverages, foods and suspended solids . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors . . . explains its acceptance by industry after industry. For further details, write for Grinnell-Saunders Diaphragm Valve catalog.



Features which have made Grinnell-Saunders Diaphragm Valves the specified valve in many different industries:

Streamlined flow. Smooth, streamlined passage, without pockets. Frictional resistance at a minimum.

Leak-tight closure against grit, scale, suspended solids.

Working parts absolutely isolated from fluid. Diaphragm completely seals off working parts from fluid in the line.

Body, lining and diaphragm materials to meet service condition. Bodies stocked in cast iron, malleable iron, stainless steel, bronze and aluminum; other materials on special orders. Valve bodies lined with lead, glass, natural rubber or neoprene. Diaphragm materials of natural rubber or synthetics.

Minimum maintenance. No refacing or reseating is required. No packing glands to demand attention. New diaphragm can be inserted without removing valve body from the line.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

(*Continued from page 92A*)

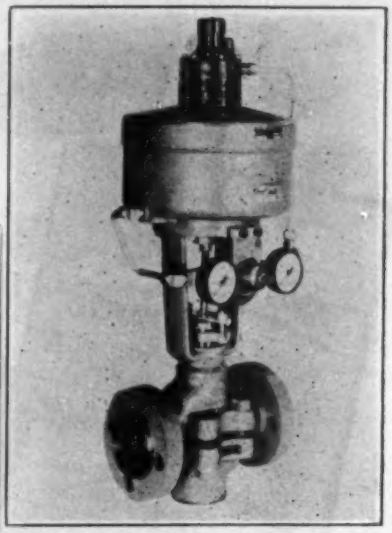
Called the Feedrator, it includes a built-in ejector which eliminates the need for a proportioning pump. A pressure differential in the main line to create a by-pass flow through the ejector is all that is necessary to operate the unit.

Many corrosive chemicals can be fed directly into the main stream because the unit is enclosed in a Lucite block. For chemical additives which Lucite cannot handle satisfactorily, the Feedrator block is also available in Uscolite at some additional cost.

Small size of the body block, 4¼ by 2¼ in., affords ease of mounting no matter how small the available space. It also helps account for the unit's low cost. Further contributing to low cost and simplicity: the pipeline adaptor screws directly into the unit's body block, requiring no additional fittings.

MacDonald Elected Executive V.P. of Sterling Engine

Sterling Engine Company, Buffalo, N.Y., has announced the election of W. A. MacDonald as executive Vice President of the company. Mr. MacDonald joined Sterling November 13, 1951, as sales manager and was promoted in December 1951, to Vice President-Sales. Mr. MacDonald is particularly well known in industrial and automotive circles, having previously served as Vice President with Hupp Motors, Willys-Overland Company and the Kaiser-Frazer Corporation.



Conoflow Announces New Control Valve Line

306

Conoflow Corporation, Philadelphia, Pa., has announced a completely new line of control valves to be known as the LB Series. Embracing a new concept of valve topworks, coupled with a completely new single seated, split body valve design, the combination results in an assembly that promises to fulfill the many exacting requirements for the accurate, sensitive and positive control of many hard-to-handle fluids.

The topwork consists essentially of an aluminum cylinder with carefully bored and honed internals, a plastic piston with graphite impregnated "O" ring seal, and an integral positioning device that permits the static or cushion loading pressure to be in either the upper or lower cylinder chamber. Coupled with the reversible Conoplug, it permits any possible combination of forces to cope with unbalanced loads, and/or requirements for predetermined plug positions on loss of operating air pressures. The operator is capable of positioning accurately to well over one part in 1000 of instrument output span.

This new valve is presently available in sizes up to and including 4", and for Series 15, Series 30, and Series 60 body ratings.

(*Continued on page 96A*)

climax BLUE STREAK ENGINES
IN NEW SEWAGE TREATMENT PLANT

The New Joint Benton Harbor–St. Joseph, Mich. Sewage Treatment Plant designed to serve an equivalent population of 75,000 is in full operation.

A novel feature is that it is of the split activated treatment type with provision for 8 MGD primary and 4 MGD secondary flow. The sewage pumps are driven by two 100 H.P., 720 RPM, 8 cylinder, Climax sewage gas engines having automatic speed control which can vary the pumping capacity from 1½ to 12 MGD.

Two 4100 CFM blowers are driven by 160 H.P., 720 RPM, 12 cylinder, Climax sewage gas engines equipped with governors having manual control for speed variation.

Climax engines were selected because of their known economy, dependability and flexibility.

This treatment plant was designed by and built under the supervision of Consoer, Townsend & Associates, Engineers.

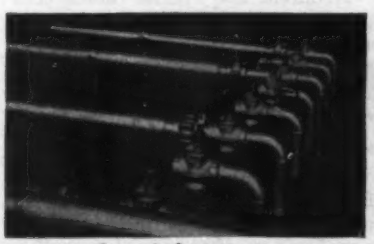
climax

FOR COMPLETE INFORMATION, WRITE TO . . .

ENGINE AND PUMP MFG. CO.
208 So. La Salle St.
CHICAGO 4, ILLINOIS
Factory–Clinton, Ia. *District Office*–Dallas, Tex.

Straight through, clean as a whistle! That's the kind of *flow perfection* you get with an A.C.F. Round Port Valve. Because they're the exact same size and shape as the pipe itself, there are no obstructions. You *always* get full capacity flow of heavy viscous ladings... without loss in head pressure. There are no abrasive effects from solids in suspension.

The full pipe area and non-wedging effects of Round Port Valves are also found in A.C.F. Rectangular Port Valves. Both are designed to give you long, trouble-free service with minimum maintenance. Don't settle for less than the very best. It pays!



The Petroleum Industry finds full-pipe area of A.C.F. Valves of great advantage on both natural gas and crude oil.

In Sewage Treatment Plants the A.C.F. exclusive Cylindrical Plug shears obstructions, provides uninterrupted flow.

In Processing A.C.F. Round Port Valves are 100% obstruction free, ideal for handling materials in suspension.

a.c.f. CYLINDRICAL FULL PIPE AREA **PLUG VALVES**

Write for Catalog 4-WS. American Car and Foundry Company, Valve Division, 1501 E. Ferry Ave., Detroit 11, Michigan.

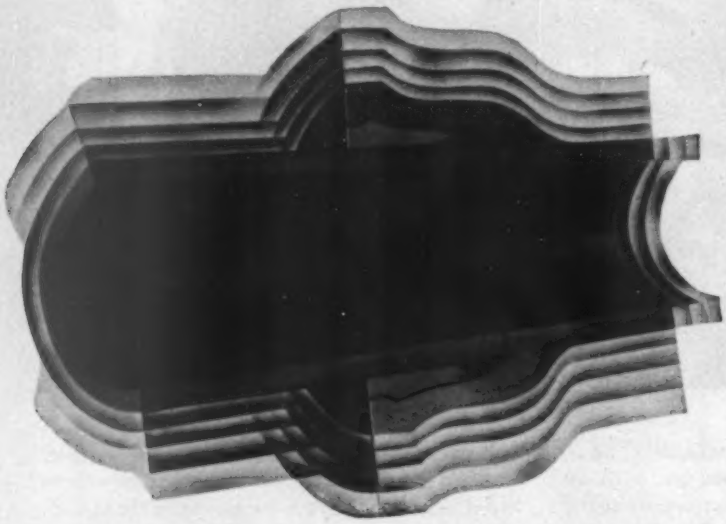
Representatives in 50 Principal Cities

Pacific Clay Products to Build Research Laboratory

Pacific Clay Products Co., Los Angeles, California, has announced that work has started on construction of their new $100,000 research laboratory at Los Nietos, California. Scheduled for completion by the first of the year the laboratory will be devoted primarily to further improving the quality of the company's clay products and to developing methods of producing longer lengths of vitrified clay pipe.

Continuing studies also will be carried on to determine means of reducing manufacturing costs. The laboratory will be equipped so as to actually simulate the manufacturing operations carried on at the company's plants in Stockton and Los Nietos, California. The latter is the largest sewer pipe plant under one roof in the world, having a capacity of 11,000 tons of finished pipe a month.

The company also announced that Meredith C. Brown, formerly director of Research and Development, has been appointed Vice President of the company, in charge of Research and Development.



A JOINT THAT KEEPS ITS HEAD ...under *STRESS* and *VIBRATION*

Long after you backfill the trench, water pipe joints poured with ATLAS MINERALEAD® provide leak-free performance without maintenance . . . protected by a bond permanently able to withstand stress, vibration and deflection.

This plasticized, sulfur base compound flows freely . . . handles easily . . . seals to a leakproof bond without caulking. In addition, ATLAS MINERALEAD melts without bubbling or frothing or settling out in the melting pot. Both time and material are saved at every step of the jointing procedure . . . as proven by over a quarter of a century of usage.

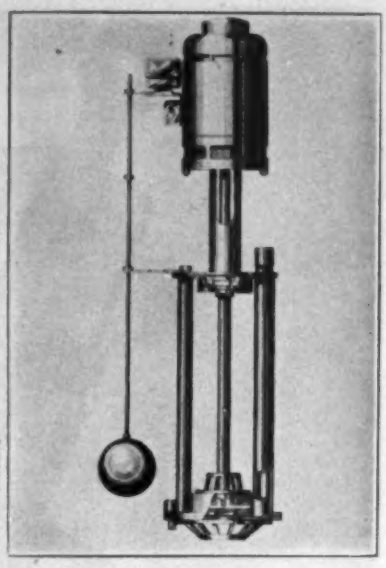
YOU SHOULD HAVE THE FACTS. Write now for Bulletin M10-1A on MINERALEAD.

OTHER ATLAS PIPE JOINTING MATERIALS
For Cast Iron Water Pipe: HYDRORINGS®.
For sewers: JC-40®, GK®, SLIPJOINT GK®.

ATLAS JOINTING COMPOUNDS
. . . a permanent bond

ATLAS MINERAL
MERTZTOWN, PENNSYLVANIA

Engineering Representatives throughout the United States



Acid-Proof Sump Pump

307

The Galigher Co., Salt Lake City, Utah, has developed a 1½" acidproof sump pump that handles acid sludges, corrosive and foamy products with solids in suspension and all types of difficult pumping where heads up to 35′ and flows to 75 gpm are required.

This simple welded steel vertical pump is completely rubber lined and covered. The overhung suspended shaft design eliminates all submerged bearings, packings and other parts which normally cause trouble in this type of pump.

The pump operates until the sump level is below the lower suction cover and will empty tanks to within 2½" of the bottom. A float switch or assembly—rubber covered and acid-proofed—can be fitted for the pump to control sump delivery.

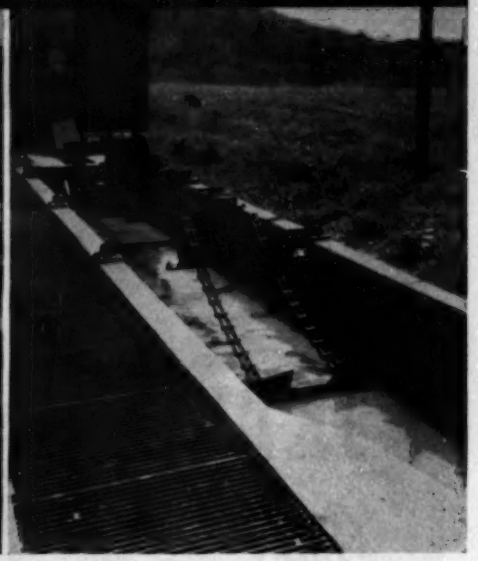
Neoprene and special rubber compounds are available for unusual applications.

Admiral Smiley Joins Sterling Engine

Sterling Engine Company, Buffalo, N. Y., has announced that Admiral Curtis S. Smiley has been appointed to the executive staff as Assistant to the President. Admiral Smiley just recently retired after 30 years' service in the U. S. Navy. Upon graduation from Annapolis in June 1923, the then Ensign Smiley reported for flight training at the Pensacola, Florida, Naval Air Station. The outbreak of World War II found him in command of Air Group Five, assigned to the Carrier YORKTOWN. He was awarded the Distin-

(*Continued on page* 98A)

JEFFREY "goes to town"...



... in the hills of Pennsylvania

Altoona, Pa., as hundreds of other municipalities in the nation, called on Jeffrey for the most modern engineered equipment for treating sewage. The above illustrations show a part of a coordinated sewage system that Jeffrey engineers designed specifically for Altoona.

City engineers prefer Jeffrey equipment. They like the way Jeffrey engineers help them develop *methods* for *results*.

Whether the problem is water, sewage or industrial wastes, rely on Jeffrey experience and engineered equipment. Write Sanitation Division for Catalog No. 833 today.

SANITATION EQUIPMENT

Sludge Collectors • Sludge Elevators • Grit Washers • Grit Collectors • Scum Removers • Spiral Conveyors • Screenings Grinders • Garbage Grinders • FLOCTROLS • Rapid Mixers • Bucket Elevators • Chains, Sprockets

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED ...IT'S A JOB FOR JEFFREY!

(*Continued from page 96A*)

guished Flying Cross for action in the first Marshall-Gilbert Islands strike in January 1942 and the Commendation Ribbon for the Salamana-Lae strike in March 1942. As commander of the escort carrier USS RUDYERD BAY, he was awarded the Bronze Star Medal for South Pacific campaigns. At the time of his retirement Admiral Smiley was Chief of Staff, Commander, Eastern Sea Frontier Headquarters, New York City. His business address will be the general offices of the Sterling Engine Company, 1270 Niagara Street, Buffalo, N. Y.

Felix W. Saco Appointed Permutit Development Engineer

The Permutit Company, New York, N.Y., has announced the promotion of Felix W. Saco to the position of Development Engineer. In his newly-created office, he will be able to devote full time to the important work of developing Permutits' varied line of industrial products. To assist him in this work, he will have a staff of designers, draftsmen and test engineers.

Mr. Saco joined Permutit in September 1952 and was assigned to the Mechanical Engineering Department to work on the design and improvement of household water softeners. He attended New York University, receiving a Bachelor's degree in Mechanical Engineering in 1940.

To the four corners of the earth PEKRUL GATES are performing efficiently and dependably. PEKRUL Water Control Equipment is designed and developed to meet the most rigid requirements anywhere in the world.

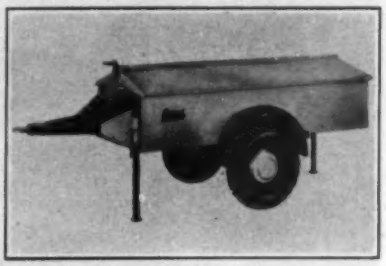
MANUFACTURERS OF PEKRUL GATES FOR

Flood Control	Sewage Disposal	Rearing Ponds
Levees	Reservoirs	Recreation Pools
Irrigation	Pumping Plants	Cooling Towers
Water Works	Oil Refineries	Steel Mills
Dams	Fish Hatcheries	

Write for Catalog 49

PEKRUL GATE DIVISION

MORSE BROS. MACHINERY
DENVER, COLORADO



Portable Trailer Type Tool Box

308

Aeroil Products Company, Inc,, South Hackensack, New Jersey, has announced a tamperproof, ruggedly built, fast trailing pneumatic-tired all-steel tool box.

Featuring rigid telescoping sturdy stand legs at each end, this roomy 6 foot box has overall length of 114½ inches including tow frame, overall height of 49 inches and loading height of 41 inches. Load capacity of 2000 lbs. is said to make this unit a natural for Contractors, Highway Departments, Public Utilities Waterworks, Maintenance and Municipal Departments, Pipe Line Companies, etc.

The Aeroil Toolbox has one padlock that protects the entire box. One man can open or close both lids from a single position. In locking, the handles pull the covers in tight, where they lock under the box rim. It is impossible to open either cover unless locking handles are released. Due to new type of construction the tow eye can be placed at any height (from 24" to 38") to accommodate various towing trucks.

Partitions and sliding trays are standard features, affording ample storage space for small tools, parts, etc.

Simplex Appoints Two New Service Engineers

Simplex Valve and Meter Company, Philadelphia, Pa., has an-

(*Continued on page 100A*)

With adequate dosages of Aqua Nuchar, water leaving your plant will be palatable and also give the appearance of sparkle that is so appealing to the eye. Besides removing the unpleasant odors, treatment of water with Aqua Nuchar gives your water that extra something to enliven consumer acceptance.

If you have customer complaints, Aqua Nuchar Threshold Odor Experts will give your plant a complete survey without obligation. They will then recommend how you can best use adequate dosages of Aqua Nuchar to bring your threshold odors down to 5. (Remember that just reducing the threshold odor from 50 to 25 will be detectable *only* by a very keen sense of smell.) The correct amount of Aqua Nuchar will deliver the sparkling, palatable water desired.

Consult with Industrial's Technical Staff about the use of Aqua Nuchar in your water treating plants.

NUCHAR

industrial
CHEMICAL SALES
division west virginia pulp and paper company

New York Central Building
230 Park Avenue
New York 17, N.Y.

Pure Oil Building
35 E. Wacker Drive
Chicago 1, Illinois

Lincoln-Liberty Building
Broad and Chestnut Sts.
Philadelphia 7, Pa.

2775 S. Moreland Blvd.
at Shaker Square
Cleveland 20, Ohio

(Continued from page 98A)

nounced the appointments of E. M. Logan and J. L. Rainier as service engineers.

Mr. E. M. Logan has been established as Service Engineer with headquarters at Woodlawn Park Apartments, 20th Avenue North, St. Petersburg, Fla. From this central point, he will handle all service engineering requirements in the states of Florida, Southern Georgia, Southern Alabama, Mississippi and Eastern Louisiana.

Mr. J. L. Rainier will be located at 1536 N.E. 39th Street, Oklahoma City, Okla., in order to take care of service calls throughout the states of Oklahoma, Nebraska, Kansas, Texas, New Mexico, Colorado, and other areas West as may be required.

American Wheelabrator Appoints Wieschaus

American Wheelabrator & Equipment Corp., Mishawaka, Indiana, has appointed Leroy J. Wieschaus to the post of District Manager of the company's Birmingham sales office. His new offices are at 805-6 Farley Building, Birmingham, Alabama, and he will handle the company's complete line of products.

Mr. Wieschaus, a registered professional engineer, has been in the home office of the company for more than seven years, holding the positions of Market Research Engineer, Assistant Sales Promotion Manager, and most recently, Abrasives Engineer.

Keasbey and Mattison's New Plant in Operation

Keasbey & Mattison Company, Ambler, Pa., has announced that "Century" asbestos-cement pressure pipe now is being produced at the new Santa Clara, Calif., plant.

Recently completed at a cost of $2,750,000, the new plant occupies a 26-acre site 40 miles south of San Francisco.

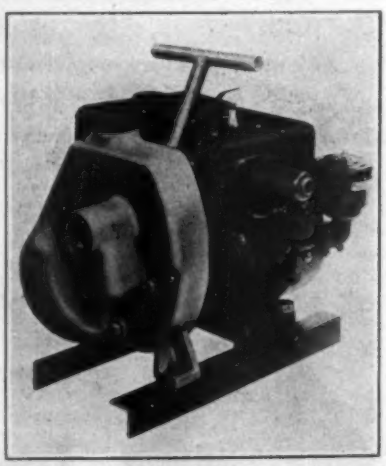
The new plant is of steel frame construction, roofed and sided with "Century" asbestos-cement corrugated sheets. The main building is 110 feet wide by 700 feet long. Total area of the plant is 182,300 square feet, with 96,000 square feet devoted to raw material storage and the remaining 86,300 square feet to manufacturing and other functions.

PROPORTIONEERS
Corrosion Control at Work

This new Proportioneers lime slurry feeding package featuring a classifying draft tube solves the complete corrosion control problem for the Jamestown Water Company in Jamestown, Rhode Island — and does the job PRACTICALLY WITHOUT ANY OPERATOR ATTENTION WHATSOEVER. It's a simple unit — a Proportioneers Heavy Duty Chem-O-Feeder mounted on an agitator-equipped tank. The milk of lime is injected into the effluent from pressure filters against a pressure of 85 p.s.i. The complete package is self-cleaning, and practically self-operating, and includes safety features which insure against failure or clogging.

Solve your chemical feeding problems with a Proportioneers equipment package. Send details for data and recommendations. Proportioneers, Inc. 350 Harris Ave., Providence 1, R. I.

PROPORTIONEERS
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • BUILDERS-PROVIDENCE, INC. • OMEGA MACHINE CO.
METERS FEEDERS CONTROLS



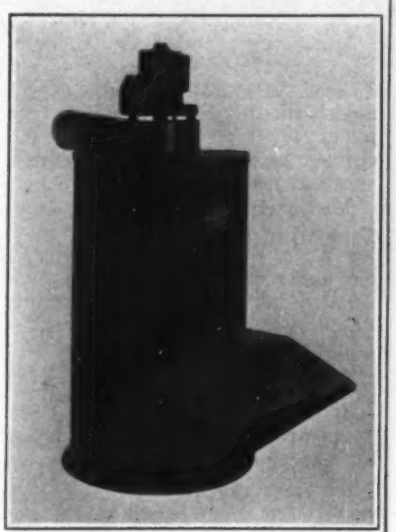
Handy Portable Pump

309

Kenco Pump Company, Lorain, Ohio, has developed a new, handy, portable pump. The new 114 pump is completely self-priming, and has no

valves or moving parts other than the motor, pump impeller and seal. It delivers over 100 g.p.m. at lowest head, and is capable of forcing water to a maximum height of 100 feet. High suction lift is assured up to and including 25 ft. of lift. It is entirely self-priming.

The Kenco 114 has an open-faced, non-clogging type impeller. It will handle all of the solids passed by the Kenco suction strainer affixed to the end of the suction hose. The impeller is fastened directly to the engine shaft without the use of couplings, key ways or other intermediate devices, and both impeller and wear plate can be replaced easily if wear or damage occur.



Dust Collectors

310

Wallace & Tiernan Co., Belleville, N. J., has developed two new models of the W & T Dust Collectors designed for the effective removal of nuisance and toxic dusts raised during hopper loading or other handling or feeding of dry chemicals.

The Hopper Mounted Model has a built-in loading chute and returns dust directly to the hopper when the filter tubes are agitated. The Floor Mounted Model has a 4″ diameter inlet connection and collects dust in a pail.

Both models are housed in a circular case approximately 5′ high and 2″ in diameter and have a capacity of 400 cfm. Dust is collected on the outside of the filter tubes and provides a total filtering area of 60 square feet. During operation, the entire collector is under a vacuum so there is no leakage of dust.

Rockwell Names Ricketts to Sales Planning Post

Rockwell Manufacturing Company, Pittsburgh, Pa., has announced the appointment of Mr. A. G. Ricketts as supervisor of the sales order department of the Company's Nordstrom Valve Division, and has been transferred to the Oakland, California plant.

A native of Pittsburgh and lifetime resident of that area, Mr. Ricketts has been with Rockwell 21 years, beginning as a storeroom clerk at the Homewood plant in 1932. He was later appointed assistant supervisor of the Nordstrom sales order department and became supervisor in 1950.

In his new position, Mr. Ricketts will coordinate joint sales planning between the Pittsburgh and Oakland plants.

EASY TO LAY

WITH UNTRAINED LABOR

SAVES TIME
REDUCES COSTS

McWane-Pacific Boltite mechanical joint pipe and fittings lay faster and reduce pipe line construction costs because the joints can be made by untrained workmen using only a ratchet wrench. Boltite is a better joint for either water or gas. Bottle-tight, leak-proof, yet flexible to allow settlement, or expansion and contraction of the pipe line.

All joint parts, glands, gaskets and bolts are interchangeable with pipe, fittings, valves and hydrants made by other manufacturers. For complete information, wire or write McWANE CAST IRON PIPE COMPANY, Birmingham, Alabama, or PACIFIC STATES CAST IRON PIPE COMPANY, Provo, Utah. (Sales offices in principal cities.)

McWANE PACIFIC PIPE Lasts for Centuries

Dickey Clay Opens Mississippi Plant

W. S. Dickey Clay Manufacturing Company, Kansas City, Mo., has announced the opening of a new plant at 5721 First Street, Meridian, Miss. It is said to be the finest and most modern manufacturing plant of its type in the nation. This most recent addition to the state's growing industrial life was constructed at a cost of $2,600,000.

According to the company the clay sewer pipe produced at the new plant will be unexcelled in many ways: It will be longer, straighter, rounder, and stronger because of the new methods and new machinery being used. The 4, 6 and 8 inch pipe is made on horizontal machines, the newest development in pipe extrusion.

The larger diameter pipe (10 to 36 inches) is also processed almost completely automatically. New type hydraulic presses form this pipe at 600 pounds per square inch, giving the product an extremely dense body and greater strength. Dickey's new plant will also produce vitrified wall coping, flue lining, drain tile, filter-bed blocks, septic tanks and flashing blocks.

The big plant has ten periodic (beehive) kilns and one continuous tunnel kiln. It has an estimated annual production capacity of 36,000 tons, with provisions for future expansion. The yearly payroll will exceed $300,000 for about 150 employees.

1. Large illustration shows Singl-use Fiberform ready to be filled.
2. Filling plate and collar simplify pouring concrete into form.
3. Completed meter box barrel.
4. Meter box with cover in place.

FOR ECONOMICAL SETTINGS

Make Your Own

CONCRETE METER BOX BARRELS *with*

FORD *Singl-use Fiberforms*

Water utilities that find vitrified or concrete tile expensive or difficult to obtain, may now make their own barrels for outside meter settings with Ford Singl-use Fiberforms which are inexpensive and easy to use. Forms made for 15", 18" and 20" ID barrels and in lengths of 15", 18" and 24". Use two for deep settings. Send for full information.

FOR BETTER WATER SERVICES

FORD

THE FORD METER BOX COMPANY, INC. Wabash, Indiana

Water Filters

311

Marvel Engineering Co., Chicago, Ill., makers of Marvel Synclinal Filters, have recently adapted all models of their Sump and Line type filters for water applications. No changes have been made in the basic synclinal design.

Maximum active filter area, longer periods of operation, no moving parts, simplicity of maintenance and other features of Marvel Synclinal Filters used in the filtration of oil in hydraulic and low pressure liquid circulating systems have been retained. Available for either sump or line installation in 8 individual capacity size units from 5 to 100 G. P. M. Greater capacities attained by multiple installations. Choice of mesh sizes ranging from coarse 30 to very fine 200 to handle various size particles.

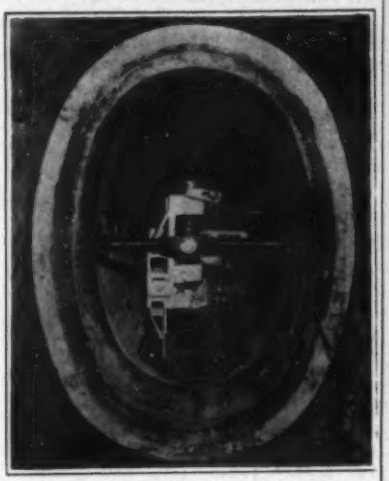
New Labyrinth Water Stop Size

312

Water Seals, Inc., Chicago, Ill., has announced a new addition to their Labyrinth line of polyvinyl plastic water stops for use in concrete construction. The new product, in a three-rib size, meets the demand for waterstop with Labyrinth characteristics in the intermediate size of concrete pours for walls, slabs, footings, etc. The two-rib size for light construction and the four-rib size for heavy pours, have proved effective in a variety of installations ranging from dams and swimming pools to underground parking lots and industrial buildings.

The new three-rib product has all the Labyrinth features: it is flexible for ease of handling and for use in curved forms; the Labyrinth design assures a permanent water-tight seal between concrete pours; the polyvinyl plastic material is impervious

to chemical deterioration in concrete; it is easy to cut and can be quickly spliced in a water-tight weld by using only a heated knife blade.



New Tunneling System for Sewer Construction

313

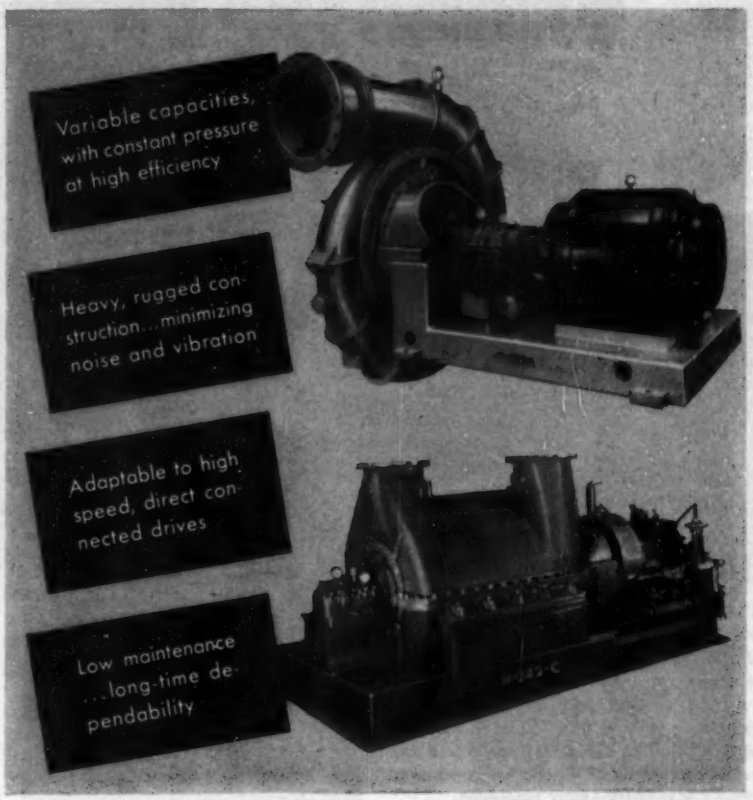
The Lamar Pipe and Tile Co., Saginaw, Michigan, has introduced the new "Inner Circles" process, using "Tunneliner" reinforced concrete pipe, that permits the construction of sewers at underground levels without disturbing the surface.

The "Tunneliner" pipe is made in short, precast, elliptical sections with a ratio of length to width permitting one section to be passed through the portion of underground sewer already tunneled. According to the company, the installation process requires less earth removal than with old methods and fewer on-the-job laborers are needed. Only simple, standard skills are required and less installation equipment is necessary. The finished sewer is stronger and has a slightly larger capacity than if built with circular pipe of the same nominal diameter.

Blewett Named President of Newport News Shipyard

Newport News Shipbuilding and Dry Dock Company, Newport News, Va., has announced that William E. Blewett, Jr. was elected President at a recent meeting of the Board of Directors. Blewett succeeds J. B. Woodward, Jr. who will retire as President of the Company after nearly forty years service, but will retain his position as Chairman of the Board. Blewett, who has been Executive Vice President since 1947, is the seventh President in the sixty-seven year history of the Newport News Com-

(*Continued on page* 104A)


Variable capacities, with constant pressure at high efficiency
Heavy, rugged construction...minimizing noise and vibration
Adaptable to high speed, direct connected drives
Low maintenance ...long-time dependability

LOOK FOR THE "BIG 4"

WHEN YOU BUY CENTRIFUGALS

Your specific needs may dictate other important characteristics in centrifugal blowers or exhausters. But even so, these four values are essential to over-all successful performance. You'll find them in every Roots-Connersville Centrifugal Unit, regardless of size. And if you desire variations to suit your application, the ability to meet these needs is a heritage of our 100 years' specializing in equipment to handle gas and air.

You'll find first-cost economies, too, in the wide range of capacities of R-C Centrifugals. From 2,000 cfm to 100,000 cfm, you can choose the single-stage or multi-stage unit most closely matched to your individual requirements. You can count on the same high quality of performance that has made many thousands of first-time buyers enthusiastic, repeat customers for R-C equipment.

For your present or future requirements, we suggest you call on Roots-Connersville, for 100 years the specialists in handling gas and air.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
354 Mount Ave. • Connersville, Indiana

Specialists in handling gas and air

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

THOROSEAL *Restored* this Filtration Plant

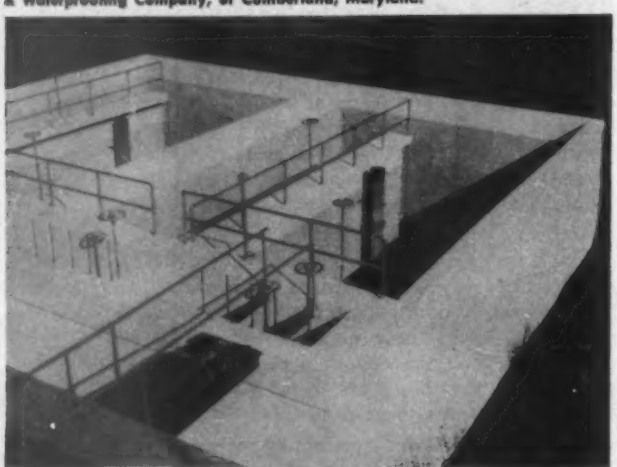
BEFORE

Example of complete break-down of masonry, due to penetration of water into body of concrete and action of frost in damp masonry.

It is amazing how THORO System products will correct a condition, such as shown in photograph. Concrete was sandblasted to remove all disintegrated material to sound concrete surface and reinforcing rods. Patching was done with THORITE Patching Mortar, bringing blistered areas to true and even lines, followed by two applications of WHITE THOROSEAL for protection.

AFTER

At minimum cost, almost ⅓ the cost of other methods, concrete restoration, patching and surface protection was completed with THORO System products on Filtration Plant in Keyser, West Virginia. Contractor: Standard Construction & Waterproofing Company, of Cumberland, Maryland.



WATERPLUG	THOROSEAL	QUICKSEAL
To Stop Leaks	To Seal Surface	For Beautiful Finish

Our 20-page Brochure describes, in detail, how The THORO System products can benefit you in your construction plan. Send for brochure today, which shows methods of application and how to use the material.

Standard Dry Wall Products

Box X, NEW EAGLE, PENNA.

(*Continued from page* 103A)

pany. As President, Blewett will be the Chief Executive Officer of the Company.

The Board also voted promotions for two other members of the executive staff, N. L. Rawlings was elected Executive Vice President and General Manager and R. I. Fletcher will become the chief accounting and financial officer by his election as Financial Vice President and Comptroller.

Literature & Catalogs

Pavement Breakers

314

Ingersoll-Rand Co., New York, N. Y., has just published a catalog entitled **"The Right Paving Breaker for Every Job."** This new piece of literature tells, concisely, the story of Ingersoll-Rand's series of Breakers from the 14 lb. J-10 to the 146 lb. R-30.

Each machine is adequately described both as to specifications and jobs it can perform. A typical cross-section view shows all the important features of the construction and design of the Paving Breaker line. Individual pictures of each help to emphasize the "Right Breaker for Every Job" theme. In addition, two pages of the 8-page bulletin illustrate the individual tools and accessories available for the complete line.

Dual-Purpose Coupling

315

Morris Coupling and Clamp Co., Ellwood City, Pa., has just published a folder on the **Morris Positive Seal Dual-Purpose Coupling.**

The folder explains the application of the device for coupling or repairing of gas, water or petroleum pipe lines. Complete price and specification data is included, and the 6-step method of assembly illustrates simplicity of design, speed of installation, and durability of the components.

Water and Sewage Works Construction

316

Baton Construction Corporation, Philadelphia, Pa., has just published a brochure which includes **Water and Sewage Works Construction** and shows specific experience in sanitary engineering projects. Pictured and described are the Porter Rapid Sand Filter Plant at Wilmington, Dela-

ware and the Sewage Disposal Plant at Pottstown, Pennsylvania, both constructed by the Baton Construction Corporation.

Buckeye Ditchers

317

Gar Wood Industries, Wayne, Michigan, has just released a new catalog showing all 9 models of **Buckeye Ditchers.**

This new catalog, well illustrated with action and still photographs, shows the many types and sizes of Buckeye Ditchers available, their digging speeds, digging depths, widths, etc. Also included in the catalog is data on engines, horsepower, machine weights, and ground bearing pressures.

Backflow Preventers

318

Backflow Engineering & Equipment Co., Los Angeles, Calif., have available a bulletin on **Reduced Pressure Backflow Preventers.**

The bulletin, by means of cross-sectional drawings keyed to the text, gives the complete operation details of the device. Pipe sizes and shipping weights are given along with a recommendation for a typical installation. The back page is taken up with flow charts for the Beeco backflow preventers.

Fusion Welded Steel Pipe

319

Southern Pipe & Casing Co., Azusa, California, has available a bulletin on **Automatic Electric Fusion Welded Steel Pipe.**

The 2-color bulletin discusses the advantages of long service and economy for the pipe as well as the protective coatings used. A series of 9 photographs gives a picture sequence of the pipe from the steel coil stage through testing, coating, etc., until it is loaded on the flat car for shipment. Charts giving safe internal working pressures and heads, and theoretical weights for uncoated welded steel pipe are also included.

Diaphragm Valves

320

Hills-McCanna Company, Chicago, Illinois, has recently published an attractive 3-color catalog on **Hills-McCanna Saunders Patent Diaphragm Valves.**

This amply illustrated 38-page catalog covers in detail: introduc-

(*Continued on page* 106A)

Making tight, dependable joint on Jeffersonville job with Ropax and Kalktite.

TO GET TIGHTER SEWER JOINTS

Jeffersonville, Ind., Specified

ROPAX® packing and cold applied **KALKTITE®** sewer joint compound

To reduce ground water infiltration to a minimum and protect against overloading the sewage disposal plant, Jeffersonville, Ind., needed positively tight, dependable sewer joints in their new 25-mile sewer project.

That is why they chose Ropax and Kalktite, recognized from coast to coast over a 30-year period for producing exceptionally fine results.

Ropax is a non-porous sewer joint packing that provides *additional* joint sealing material. It forms a solid, watertight seal when caulked back in the pipe bell and permits proper pipe alignment. Available in ¾" to 1¾" diameters, there is Ropax packing for all sizes of bell and spigot pipe.

Kalktite is a sewer joint compound that is mixed and applied *cold* on the job. It sets up even under the most adverse pipe laying conditions, forming a dense, tough and flexible seal that allows normal sewer line settlement and alignment deflection. Economical to use, Kalktite allows installation of more joints per man, per hour, per day.

***WRITE TODAY** for samples and new catalog with detailed information on getting better, tighter sewer joints with Ropax and Kalktite.*

PRESSTITE Sealing Compounds

PRESSTITE ENGINEERING COMPANY

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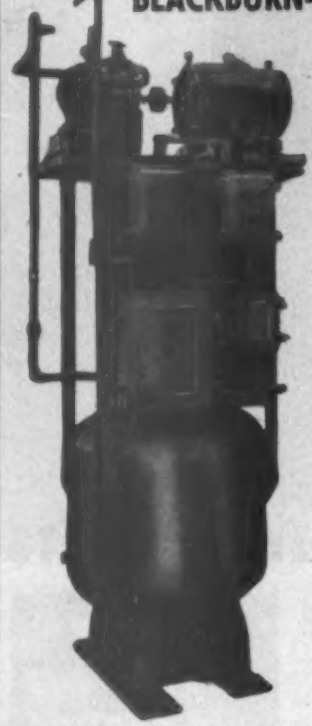
● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.



BLACKBURN-SMITH SEWAGE EJECTORS

RATED TO HANDLE

12,000 GPM OF SEWAGE

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The above figure represents the rated amount of sewage handled by Blackburn-Smith ejectors in one year alone, attesting to the wide usage and desirability of a good, dependable, rugged pneumatic sewage ejection system.

30 to 500 GPM in both single and twin units against high discharge heads.

Exclusive Modern Features

Over 50 years service has proved the worth of Blackburn-Smith Ejectors. Yet our today's product is full of exclusive modern features such as:

1. Float and electrical float switch controls.
2. Float and pneumatically controlled snap action valve.
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Any one of the above, with or without Air Receivers. Get Catalog S.

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REctor 2-9360

Compact ejector system having motor compressor assembly and all controls in one "packaged" unit.

NO OTHER PIPE JOINT Can Equal BOND-O

- In First Cost
- In Uniformity
- In Performance

A careful survey of pipe joint costs will surprise you as to how much you can save with BOND-O. The low installation cost as well as a perfect performance record proves that nothing else equals BOND-O.

This self-caulking compound is accurately formulated and is used for jointing cast iron bell and spigot pipe.

Machine-blended by a unique process, BOND-O makes joints that are uniform and trouble-free. No BOND-O failure has ever been reported.

Write for literature today.

NORTHROP & COMPANY, INC.
SPRING VALLEY, N. Y.

(*Continued from page* 105A)

tion to the valve; operating features; installation views; operating data and typical services; selection, sizing and ordering; methods of operation; body materials; diaphragm materials; specifications for handwheel, lever, sliding stem, and air operated valves; and data on other valves and special equipment. The inside back cover lists the names and addresses of Hills-McCanna sales representatives in 16 different locations in the country.

Pipe Cutter

321

Ellis & Ford Manufacturing Co., Ferndale, Michigan has available a 4-page bulletin on the **Ellis Pipe Cutter.**

The bulletin describes the cutter as being an all-purpose cutter that cuts pipe in or out of ditches, corners or other tight places. Complete details of the two models, as well as a list of parts, are given along with prices and shipping weights. The back page is devoted to Ellis pipe clamps and plugs.

Saran Lined Pipe, Fittings and Valves

322

The Saran Lined Pipe Company, Ferndale, Michigan, has available a 32-page bulletin on **Saran Lined Fittings, Pipe, and Valves.**

This profusely illustrated bulletin covers saran lined steel pipe; malleable iron union fittings; cast iron flanged fittings; cast steel flanged fittings; reducing and blind flanges; spacers; saran rubber gaskets and sheet packing; plug, diaphragm and check valves. Typical connections and the fabrication of saran lined pipe is shown by means of cross-sectional drawings. Chemical resistance of saran, operating temperatures and flow characteristics are also given. A temperature conversion table completes the bulletin.

Three Full-Color Bulletins Describe New G-E Line of Tri-Clad Motors

323

General Electric Company, Schenectady, New York, has just published three new four-color, picture-story bulletins describing the recently announced line of **Tri-Clad "55" Motors,** built in 1-30 hp. ratings to latest NEMA dimensions.

The publications contain complete descriptions of new mainte-

nance, performance, and protective features of the line, and each includes a double-spread cutaway drawing of the motors. A 16-page booklet covers dripproof models; enclosed motors are presented in an 8-pager; and a 14-page bulletin describes the new gear motors.

Diatomite Filters

324

The General Filter Company of Ames, Iowa, has a new illustrated folder available, which affords information on **Diatomite Filters.**

As explained in the bulletin the use of diatomite filters is becoming more widely known as this equipment is frequently specified for swimming pool systems. They are successful in filtering oil from contaminated water and were used by the Armed Services to filter out water organisms that produce sickness and disease if taken into the human system.

In addition to giving the specifications, a typical swimming pool installation is shown in detail together with a cut-away illustration of the diatomite filter.

Bulletin Outlines Ion Exchange Technology and Industry Uses

325

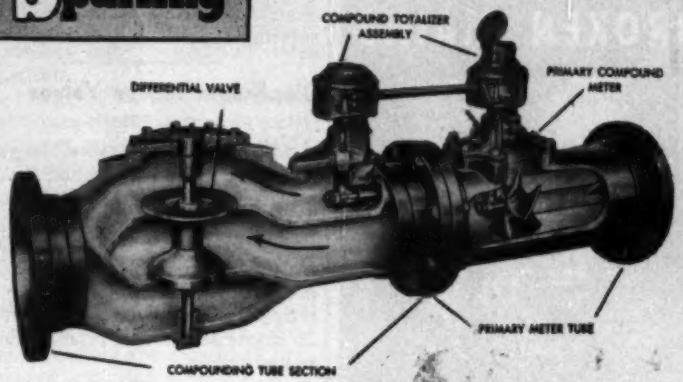
Rohm & Haas Co., Philadelphia, Pa., has just published a new 16-page illustrated bulletin, "Amberlite Ion Exchange," that gets back to fundamentals and answers such questions as: What is ion exchange? How and where is it serving industry? By relating ion exchange technology to familiar examples, the bulletin offers readily understood explanation of this relatively new unit operation and its growing domain.

Fundamental ion exchange processes are described with the aid of a full page of two-color drawings. In the introductory section is a brief history of synthetic resin ion exchange development as well as explanatory material on regeneration and deionization.

In the application section, the field is broken down into 13 process types: water conditioning for industry and home; removal of metal ion contaminants, recovery of metallic ions; recovery and purification of organic bases; deacidification of solutions; recovery of acidic constituents; adjustment of metal ion concentration; catalysis by acids and bases; fractionation of ionic constituents; the conversion of salts

(*Continued on page* 108A)

Sparling WATER CONTROL EQUIPMENT



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DAM REPAIRED WITH "GUNITE"

The two photographs show the Bulls Bridge Dam of the Connecticut Light and Power Company, which is one of many dams we have repaired for this company.

The upper view shows the work in progress, and gives some idea of the condition of this structure before repairs were made. The lower view is of the completed job.

After chipping out the loose and disintegrated concrete and sandblasting the entire area, heavy reinforcing mesh was placed over the surface of the old concrete and "GUNITE" applied two inches thick, plus the material required for filling deeply eroded portions.

Our 72-page bulletin C-2400 describes scores of similar "Gunite" jobs.

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SKINNER-SEAL Split Coupling Clamp for dependable and lasting repair of broken mains. Sizes 2" to 24" inclusive. Write for catalog.

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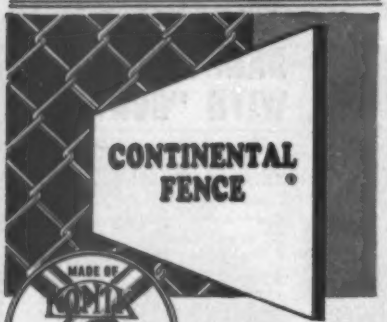
SOUTH BEND, INDIANA



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STEEL CORPORATION • KOKOMO, INDIANA

(*Continued from page* 107A)

by double decomposition; analysis, deionization; pharmaceutical and medical uses. Within each group, examples show how ion exchange is solving specific industry problems.

Diaphragm Motor Valves

326

Minneapolis-Honeywell Regulator Co., Philadelphia, Penna., has just released a twelve-page Bulletin that describes the high quality, low cost Series 362 line of **Diaphragm Motor Valves** for on-off or narrow band proportional control. Complete specifications are given for both type 26 single seated and type 27 Bellows sealed valves.

Sterling Slo-Speed Electric Power Drive Scale Drawings

327

Sterling Electric Motors, Inc., Los Angeles, Calif., has announced the availability of a new set of **Scale Drawings for Geared Slo-Speed Electric Power Drives.**

These Templets have many uses: Engineers will find convenient in layouts—Draftsmen can save time in scale drawing work—Estimators will use on preliminary layouts—Accurate clearance information can be determined—quick, clean layouts can be made.

The folder includes 22 separate sheets with each sheet numbered for easy refiling. Three views of the Slo-Speed Drive are detailed on each page with the frame and type drawn to 3 separate scales: ¾"=1'; 1"=1'; 1½"=1'. All ratings from ½ H.P. to 30 H.P. are included in the folder. The drawings are adaptable to almost any drafting requirements.

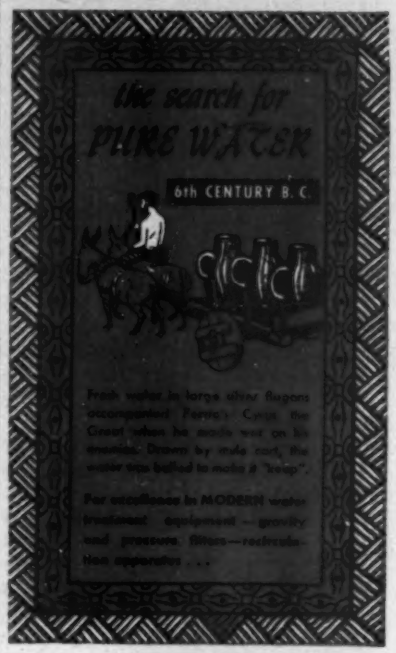
Dorrco Distributor

328

The Dorr Company, Stamford, Conn., has announced the availability of a new twenty-page, two-color bulletin, **"The Dorrco Distributor."**

The bulletin describes Distributor types, sizes and capacities, operating and mechanical features, and applications to both high and low rate trickling filter treatment. Also included are photographs of actual installations as well as cut-aways and wash drawings illustrating mechanical details.

According to the bulletin the distinguishing mechanical features of the unit include a quick opening dump gate at the end of each arm to permit easy flushing, adjustable orifice slots to allow final flow regu-



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- *Low loss of head*
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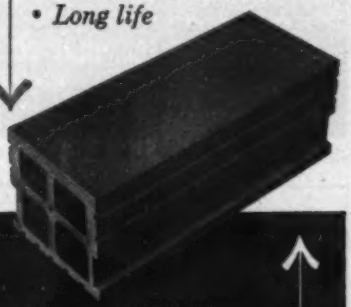

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Today, in more than 250 plants with a daily capacity of over 1¼ billion gallons, Leopold Duplex Filter Bottoms are providing dependable, economical service with minimum maintenance.

Made of highest quality de-aired fire clay—vitrified and salt glazed, the Leopold Filter Bottom requires only a shallow depth of small sized, inexpensive filter gravel to support the filtering medium. Further, the laterals and distributing blocks are all combined in one strong permanent unit that will last indefinitely.

Adaptable to any rectangular filter unit, the Leopold Glazed Tile Filter Bottom is designed to successfully meet all underdrain requirements.

Each Leopold filter block is about 2 sq. ft. in area—weighs approximately 100 pounds.

Complete Water Purification and Sewage Plant Equipment . . .

- DRY CHEMICAL FEEDERS
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lation and minimize clogging, and a positive air seal to protect the mercury seal between the rotating and fixed elements from physical contact with sewage. A large ball bearing race running in oil at the turntable base insures stability and facilitates lubrication.

The bulletin further states that this self-propelled machine is available in sizes ranging from 20 to 200 ft. in diameter and capable of handling 60 to 22,000 gpm. Variations of the unit include either two or four arm models, and arms may be of single or double compartment design. In small treatment plants one Distributor can be employed to feed both primary and secondary filtration stages when the two filter beds are located concentrically.

Light-Weight Spur Gear Hoist

329

Coffing Hoist Company, Danville, Ill., has just published a new four-page, two-color bulletin describing the **Coffing Challenger.** The Challenger is a light-weight spur gear hoist of formed steel construction that features easy portability and resistance to shock load breakage.

Included in the bulletin is a cutaway drawing indicating its simplicity of design and ease of servicing. Other hoist features, dimension drawings, and specifications for the ½-, 1- and 2-ton models are also included.

Large A-C Motor Control

330

Electric Machinery Mfg. Company, Minneapolis, Minnesota, in a special 36-page issue of the "E-M Synchronizer" presents, **The ABC of Large A-C Motor Control,** in an easily understood manner the basic facts helpful in the proper selection and application of controls for large industrial motors.

This booklet contains more than sixty illustrations and charts which are explained and discussed in the accompanying text. In addition to describing the various control arrangements available for large motor application, the booklet includes discussions of the latest developments in motor and personnel protective features.

Differential Flow Meter

331

Hays Corporation, Michigan City, Indiana, has just published an 8-page booklet on the **Hays Diaflow Meter.**

(*Continued on page* 110A)

NEW!

ARDCO

FOR *RAPID* POLAROGRAPHIC ANALYSIS

- **Compact**
- **Portable**
- **Easy-to-Operate**

MOD. 535
270.00

Cut down time and save operating costs on your disposal plant! Use the new Ardco for D O determination and oxygen utilization rates for the most efficiency. The new Ardco Model 535 is battery operated, making it completely portable and ideally suited for laboratory and field work. It will measure any ion capable of being reduced. With a few minutes instruction, anyone can operate it. Knob controls permit the selection of working voltages up to 3 volts and current multiplications to 24 micro amperes. Write for complete information.

GENERAL

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

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RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

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St. Louis Turbidimeter

For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical wells for holding two Nessler tubes.

This apparatus comes ready to plug into 115 volt line, comes fully equipped for normal operation.

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

(*Continued from page* 109A)

The booklet describes the meter as being ideally suited for sewage disposal plants, industrial furnaces, and cost accounting. Among the features discussed are: pilot method of operation; dry diaphragm-type measuring element; and package unit construction.

Sewage and Sump Pumps

332

American-Marsh Pumps, Inc., Battle Creek, Michigan, has published a bulletin on **Non-Clog Sewage and Sump Pumps.**

The bulletin discusses three types of pumps: vertical, wet pit, single or duplex; vertical dry pit; and horizontal. Keyed, cross-section drawings with explanatory text, point up the features of the three pumps. Specifications, performance tables, and installation dimensions are also given.

Water Analysis Chemicals

333

Hach Chemical Company, Ames, Iowa, has released the new **HachVer Catalog.**

The catalog discusses the various chemicals made by the company for use in water analysis. A new reagent named MonoVer is explained in detail and the Hach MonoVer total hardness test, as well as other systems are covered. The second half of the catalog is devoted to complete listings of equipment and chemical prices.

Small Capacity Controlled Volume Pumps

334

Milton Roy Company, Philadelphia, Pa., recently released a new catalog covering their **"miniPump"** line of **Controlled Volume Pumps.** The new bulletin gives complete data on capacities, pressures, materials of construction as well as operating details.

Some of the many variations of this line are illustrated to show typical speed and stroke length control of capacity; constant flow; air operated; and multi-plex Units. Cutaway Views illustrate the ex-

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clusive Milton Roy Step Valve and the new Double Ball Check Column Valve Liquid Ends—both of which are available in the "miniPump" design.

Chemical Treatment of Water

335

Lapp Process Equipment Division, Leroy, New York, has just published a bulletin on the **Chemical Treatment of Water with Lapp Pulsafeeder.**

The bulletin discusses the different types of Pulsafeeders and the center pages show an exploded type line drawing of the feeder with text explaining the various functioning parts. Pages 3 and 4 show drawings of typical applications in the pumped water supply, gravity water supply, swimming pool water supply and sewage treatment. A table of sizes, capacities and shipping weights along with specifications complete the bulletin.

Non-Clog Sewage and Sump Pumps

336

American-Marsh Pumps, Inc., Battle Creek, Mich., has just published a comprehensive 8-page bulletin on **Sewage and Sump Pumps.**

The bulletin describes in detail three types of pumps: the NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. Complete specifications are given for all types and optional equipment is illustrated and explained.

Performance tables are supplied according to pump capacity and detailed help is given for selecting the correct pump. Dimension drawings are shown to aid in specifying these models, and help in preparing engineering layouts.

Materials used and design of the pumps are fully explained to show how efficient non-clog performance is achieved. The bulletin is particularly useful in that complete data are given in easy-to-use form.

Pipe Tools

337

Beaver Pipe Tools, Inc., Warren, Ohio, has recently produced a condensed, 8-page quick-reference catalog covering their entire line of **Pipe Tools.**

Printed in two colors, and complete with user's prices, this new Quick Reference Beaver Catalog carries all necessary information on Beaver Pipe and Bolt Threaders, Square End Sawing Vises, Pipe Reamers, Cutters (power and hand), and Pipe and Bolt Machines. Also included is the new Beaver Model "D" Power Drive, the Beaver No. 55 Nipple Chuck and the newest additions to the Beaver line, the No. 2 and No. 4 Direct Pressure Pipe Cutters.

This catalog can be punched and inserted in a three-ring binder for easy, quick reference.

Sewer Compound Melting Pots

338

Aeroil Products Company, Inc., South Hackensack, New Jersey, has released a brochure on **Sewer Compound Melting Pots.**

The brochure illustrates and describes in detail the latest in portable wheeled pots for the melting and heating of sewer pipe and electrical pipe compounds, such as Sewer-seal, G-K, Hydro-tite, Mineral Lead, Enamels, tar, etc. The units come equipped with either kerosene burner outfits or bottled gas burners.

Multi-Purpose Sump Pump

339

Kenco, Inc., Lorain, Ohio, has released a new folder describing the new 109 **All-Purpose Sump Pump.** The 3-color brochure illustrates details of construction with cross section illustration of the pump and switch. Working principles of the pump and switch operation are detailed in a series of drawings, showing each phase of operating control. According to the folder, the new 109 features an improved liquid level control switch and incorporates features for greater simplicity and longer switch life.

For Sale

Pump No. 1.—Fairbanks-Morse Pomona Turbine, 15 horse power—Electric, 150 G.P.M., 1750 R.P.M., 3 phase, 60 cycle, 230 or 440 volts, 200' head, Style 1073614, Serial AK 1001.

Pump No. 2.—Frederick Pump, Centrifugal, 100 G.P.M., 400' head, 2,000 R.P.M., Serial 9,966, Size 2½", 3 Stage pump.

Pump No. 3.—Pomona Turbine Pump, 100 G.P.M., 300' head, 60 cycle motor, 1465 R.P.M., Serial S.D. 2248, Steel Tower Mounting.

In addition to the pumps, we also have fittings, switch boxes etc.

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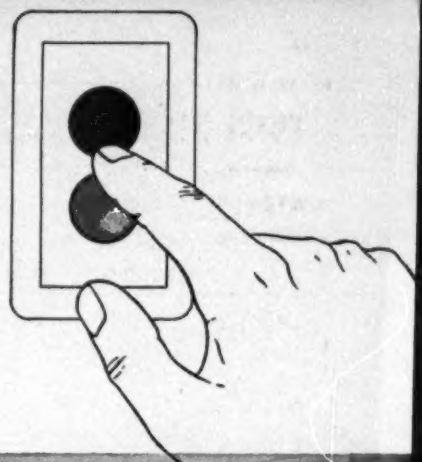
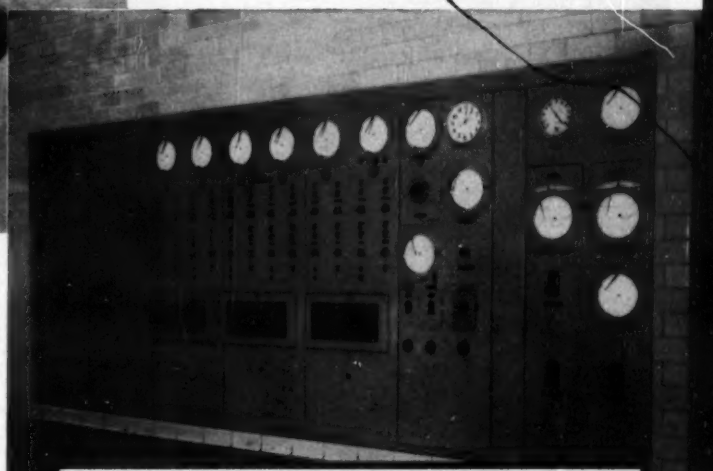


▲ Aldrich Purification Units and Filters at Alexandria plant of American Water Works Service Company.

Central control panel in pump and chemical feed building. From this board, the filter effluent and backwash rates are remotely controlled by means of Builders Auto-Central Control. ▶



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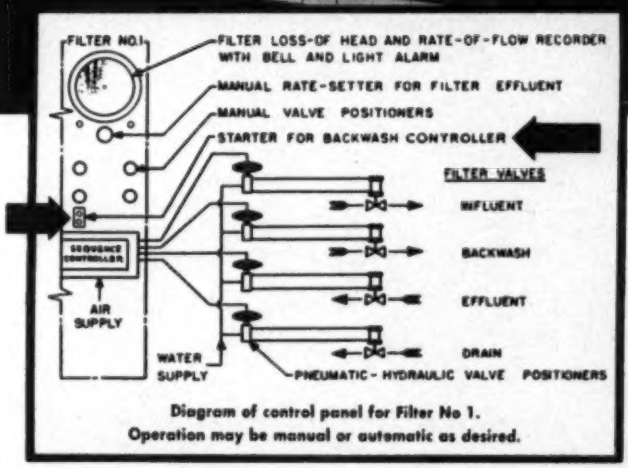

Diagram of control panel for Filter No 1.
Operation may be manual or automatic as desired.

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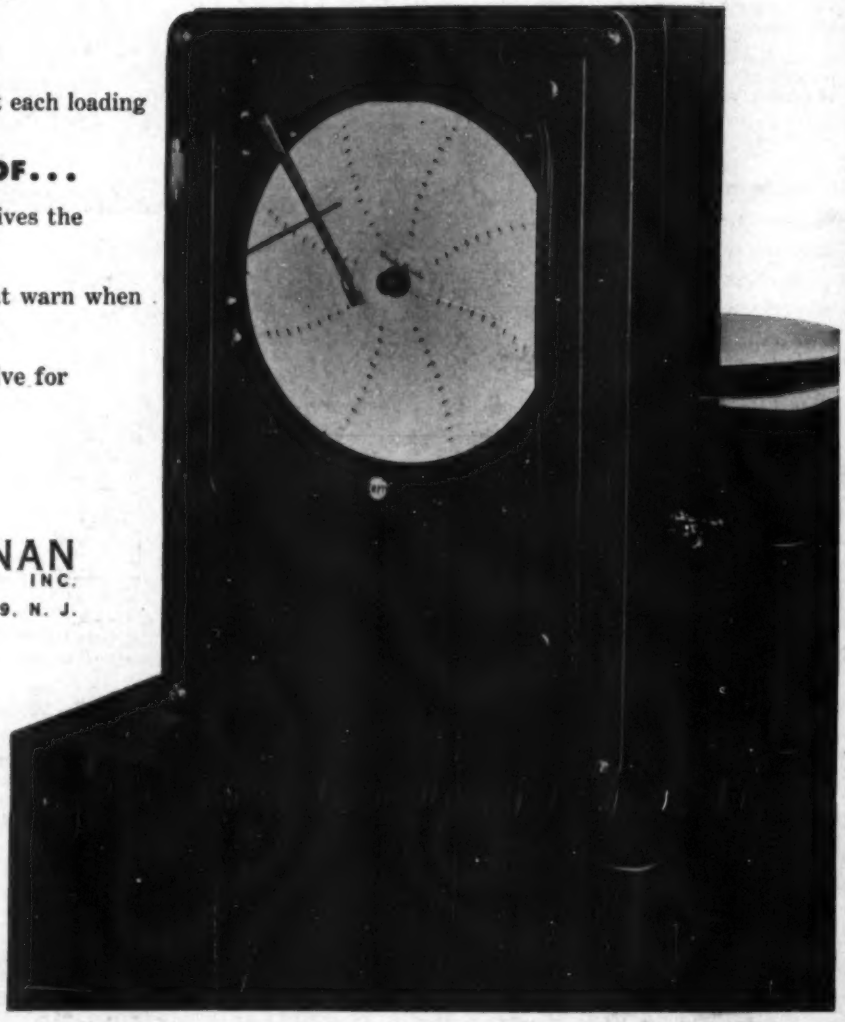

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TP-75-C-2 gives further information on the W&T Series A-635 Volumetric Fluoridator

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